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THE UNKNOWABLE.

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WORSHIP OF THE SUN-GOD.

BEFORE turning from the consideration of the virgin-born Sun-god, naturally recognised, among nations worshipping the sun, as new-born with each new day, with each new year, and with the beginning also of longer periods forming Great Years, I may call attention, in passing, to the possibility that we may find in this belief the explanation of a curious passage in classical literature, which has long been regarded as enigmatical.

In Virgil's "Pollio" we find the lines:

> Jam redit et Virgo, redeunt Saturnia regna;
> Jam nova progenies cælo dimittitur alto. . . .
> Te duce, si qua manent sceleris vestigia nostri,
> Irrita perpetuâ solvent formidine terras . . .
> Pacatumque reget patriis virtutibus orbem;

which may be rendered: "Now returns the Virgin, Saturnian realms return; from heaven above an offspring new descends. With thee to guide, if any traces of man's wickedness remain, failing they shall free all countries from perpetual dread . . . He shall govern the world in peace, with the virtues of his father."

It will be observed by those who have considered our account of the expectations associated with the birth of each new sun-god—akin, but on an enlarged scale, to the hopes men form with the birth of each new year, nay, of each new day—that the above passage presents the same hopes, the same aspirations. We are thus led to regard the reference to the Virgin as no accidental coincidence. All Virgil's astronomical references belong to a time long preceding his own. For instance, he speaks of the time of year—

> Candidus auratis aperit cum cornibus annum
> Taurus . . .

—"when the white Bull opens the year with his gilded horns"; whereas for two thousand years before his time spring had opened with the sun in Aries, not in Taurus. We know not from what source Virgil derived his astronomy; it is evident only that, like the astronomy of Aratus (borrowed from Eudoxus), the astronomy of Virgil was not his own.

But it chances that we do know something of the source from which Virgil's "Pollio" was in large part derived. That Eclogue was taken from a Sibylline prophecy, though, doubtless, Virgil used all a poet's license in the use of the sacred leaves from which he borrowed his inspiration.

Now, the very antiquity of the Sibylline Prophecies—an antiquity so great that the origin, and even the authenticity, of most of them is altogether lost—would assure us, apart from other evidence, that they related to the early, widespread, and reasonable worship of the sun, a cult which was in truth, while it lasted, the worship of the unknown and seemingly unknowable Power of which the sun seemed to be the visible manifestation. We might safely infer that the Sibyls had an office akin to that which we recognise in Deborah and in Huldah the prophetess—viz., to determine, as by a sort of divine inspiration (like that of the Delphic priestesses), the proper forms for the worship of the Unknowable. But we are not left to deduce this inferentially. We have historic evidence that the Sibyls were priestesses of the Sun-god. Thus Pausanias preserves the inscription on the monument erected to the Samian Sibyl in a grove sacred to Apollo Smintheus (Apollo being the Sun-god, in his character as dispeller of the darkness of night and of winter). A hymn to the same god, well known to the inhabitants of Delos in the time of Pausanias, was attributed to the still more ancient Erythræan Sibyl, who was supposed to have predicted the issue of the Trojan war. There were many sibyls, however, all belonging to races which were either sun-worshippers of their own notion, or had borrowed sun-worship from races of earlier civilisation—as the Egyptians, Babylonians, and Persians on the one hand, and the Hebrews, Greeks, and Romans on the other.

We may recognise, then, in Virgil's lines a very curious relic of ancient sun-worship. The original sibylline verses from which he borrowed formed doubtless a song welcoming the birth of the sun-god, and expressing the customary aspirations regarding the time heralded by his arrival.*

Pursuing further the features in which the ancient myths of sun-gods and their birth resembled each other—as they naturally would in all circumstances having an astronomical or otherwise physical interpretation—we find in nearly every case the following circumstances:—

First, the birth of the sun-god ruling the new year was announced by the appearance of a star in the east.

Secondly, the sun-god was born in a cave, and attended on by herdsmen—cowherds, shepherds, goatherds, according to the habits of the race to which the myth belonged.

Thirdly, gifts of precious stones or gold, of perfumes, and of substances suitable for sacrificial fires, were offered in honour of the new-born sun-god.

Strange as such circumstances as these may appear to the philosophical mind, they seemed natural enough in the days to which they properly belonged. The astronomer of to-day may be disposed to smile at the thought that a Being worshipped as God of the Universe should be regarded as honoured by the appearance of one star among the millions of millions of suns within his domain. And it may appear still less respectful to absolute Deity to picture It as receiving with satisfaction the adoration of cowherds, goatherds, or shepherds, and gifts of objects as useless to Infinity as they would be unsuited to a babe. But the worshippers of the Buddha, Crishna, Mithras, Apollo, Serapis, and the rest, must not be blamed for retaining ideas belonging to a religion so ancient that its origin could not be traced by

* Pope calls attention to the "remarkable parity between many of the thoughts in the 'Pollio' of Virgil and those in" the passages of Isaiah imagined to have been prophecies of the coming of a Messiah: "Behold, a Virgin shall conceive and bear a son"—"Jam redit Virgo jam nova demittitur cœlo alto progenies." "Of the increase of his government and of his peace there shall be no end"—"Illo duce, sceleris vestigia nostri irrita perpetuâ solvent formidine terras." "Upon the throne of David [his father] and upon his kingdom to stablish it with justice for ever and ever"—"Pacatumque reget patriis virtutibus orbem." Accordingly Pope is tempted to follow Virgil in making an eclogue out of the mystic sayings of supposed prophecy, calling the poem "'Messiah, an Eclogue,' in Imitation of Virgil's 'Pollio.'" Herein perhaps Pope "builded better than he knew," becoming one of a very long line of adapters of sun-worshipping ideas to specific race-religions.

them, and so widespread that they might well be excused for regarding it as universal. The idea that honour had thus been rendered to Deity had arisen when as yet the idea of Deity was imperfect; and there was certainly no intentional insult to Deity in the continued association of these time-worn yet venerable ideas with the idea of the Infinite, the Unknown, the Unknowable Power, which lies beyond the sun in his might, beyond all the glories, seen and unseen, of the infinite universe, and behind its most awful mysteries.

Whatever opinion we may form as to the reasonableness, or (with our knowledge) as to the propriety, of the ideas here considered, there can be no question as to the actual fact that in all sun-worshipping religions, and in all religions derived from them or retaining their ceremonial, these ideas prevailed. It is obvious, indeed, that men in those days would feel that they were wanting in respect if they did not associate with their sun-god the same idea of the obeisance of nature which they regarded as appropriate to ordinary kings and heroes. As Dr. Geikie correctly remarks in his "Life of Christ"—though he strangely fails to note the significance of the fact—"It was universally believed that extraordinary events, especially the birth and death of great men, were heralded by appearances of stars, and still more of comets, or by conjunctions of the heavenly bodies." A preposterous belief truly; but not so at the time when it was thus universally accepted. *We* perceive the folly of it; *they* regarded it as too natural to be questioned: some, of whom Drs. Farrar and Geikie may be regarded as types, can at one and the same time perceive the folly of the belief, and accept the universality of this false belief as evidence for a recorded event.

Even the Egyptians and Babylonians, far as they were from perceiving the inherent absurdity of sun-worship, were too well acquainted with astronomical laws to fall into the mistake of imagining casual stars as heralds of great events. They knew that known stars heralded definite astronomical events. The heliacal rising of some known star in any given era—lasting several hundred years—marked for them the beginning of the annual career of their sun-god. The appearance of this star in the east before sunrise would be the manifestation of the birth of the sun of the year. Accustomed, as we find they were, to recognise a slow and gradual change in the season of the heliacal risings of the stars, they might well recognise the beginning of some new and fortunate era when first some conspicuous star rose heliacally at the birth of the new year. But in any case the annual heliacal rising of the star which showed that the new year had begun would be welcomed with rejoicings. Those who "blew up the trumpet in the new moon" would welcome still more solemnly the new sun. The ruler of the year was naturally held in higher honour than the ruler of the month. When the priests, who were also the astronomers or magi, announced that they had seen the star of the sun-god in the east (that is, rising heliacally), all sorts and conditions of men would be expected to offer praises to the new-born monarch of the year. Sacrifices and burnt offerings, with perfumes and sweet savours, would be offered by the priests. No other annual observance would appear so sacred except that belonging to the time when the sun, thus born weak and lowly, in the depressed part of the zodiac which might be compared to a cave,* should pass to the glorious part of his career.

Let us, however, see how far the ancient stories of sun-gods agree in presenting the three features mentioned above.

(To be continued.)

MR. FROUDE ON GREATER BRITAIN.*

F Mr. Froude's special purpose in writing "Oceana" we wish to say little here. In truth, the problem with which he undertakes to deal is one of considerable complexity. We doubt whether he or any man can really form an opinion as to the future development of Oceana, or the best way in which that development may be directed. Our view of his opinions about this difficult problem may be best expressed perhaps in words of his own—whose application, however, to social science we consider unsound. "It is in the marvellous power in men to go wrong," he says, "that the impossibility stands of forming scientific calculations of what men will do before the fact, or scientific explanations of what they have done after the fact."... In history "the phenomena never repeat themselves. There we are wholly dependent on the record of things said to have happened once, but which never happen or can happen a second time. There no experiment is possible; we can watch for no recurring fact to test the worth of our conjectures." If Mr. Froude, whose favourite literature is the literature of ancient Greece, believes that the study of history cannot enable us to conjecture the probable future of States under conditions seemingly resembling those which existed in former times, it

* In the case of Herakles, this same part of the zodiac was represented as a stable to be cleansed by the might of that solar hero from the gloom and darkness which seem to defile it. This zodiacal task was not associated with the birth of Herakles. His first achievement was strangling the serpents which represent the clouds of night. Throughout the ancient solar myths we recognise the intermixing of ideas relating to the sun as god of the day and to the sun as god of the year—Herakles and Iole at morn and eve (the time of the birth and death of the day sun), and Herakles strangling the serpents, these stories relate to the day, while Herakles going through his twelve zodiacal labours and Herakles conquering the Lernæan Hydra (the clouds of winter) are stories belonging to the year. The same difficulty is found, and the same explanation presents itself, in the story of Samson (Shemshin, from the older Shamash, the sun), which is unmistakably a solar myth; but most of the story of the Semitic solar hero relates to the sun as ruler of the year. Dalilah, "the languishing one," represents winter. The hero's hair, as in all sun stories, represents the sun's rays. The Philistines are the clouds, which darken (or blind) the sun when his rays have been cut off in winter. The destruction of the Philistines at the time of their celebration in honour of the fish god, Dagon (the winter deity supposed to have triumphed over the sun as god of summer), represents the triumph of the sun when, at spring, he returns to the glorious part of his course, over the clouds of winter, by which, till then, he had been, as it were, imprisoned. Yet many of the triumphs of Samson over the Philistines obviously represent the triumph of the sun of day over the gloom of night. The Gaza story combines both ideas. It represents the triumph of the midsummer sun, manifesting its power when, as yet, the middle of the night is scarcely past. All the absurdities of the story of Samson, considered as relating to a ruler or judge in Israel, disappear, and the interest it derives from its venerable antiquity is developed, when it is thus read as a very ancient adaptation—scarcely altered in the adapting—of a far more ancient myth.

In the same way the story of Jonah loses its absurdity when we recognise Jonah as identical with the Oannes of the Chaldeans, the winter god or hero, issuing from the great fish which represented the gloom and cold of winter. So reading the strange old story, we need no longer be concerned to inquire what sort of a fish that may have been which could swallow a man whole, and in whose interior a man might remain alive three days and three nights. Indeed, many occasions for somewhat degrading attempts to reconcile the impossible and absurd with known facts might be avoided if men would be content to take the stories and myths of ancient days for what they obviously are, instead of insisting on believing in them as records of historical events.

* "Oceana; or, England and her Colonies." By James Anthony Froude. London: Longmans & Co.

seems unlikely that he should hope to arrive at assured convictions respecting the future fortunes of communities like the English-speaking colonies under conditions utterly unlike any of which history has yet left us the record. We reject Mr. Froude's doctrine that a science of history is impossible, but we may believe with him that at present no such science exists; and we may feel absolutely assured that this opinion is sound so far as it is based on internal evidence. Therefore we cannot attach any great importance to Mr. Froude's views on the future of England and her colonies. The subject would tax the fullest powers of a science which by his own account will never exist. Even if he is in this mistaken, and the science already exists, it certainly is but in its infancy; and Mr. Froude's own assurance should satisfy us that he himself has no inkling of its teachings.

We propose to consider "Oceana" as a contribution to that department of literature which Mr. Froude says is provided "for those who want to be entertained without feeling that they are losing their time." As a book of travels "Oceana" is chiefly remarkable for the wideness of its range and the confident interpretation of the bird's-eye view which such a survey can alone afford. Mr. Froude pronounces an opinion on the climate of the middle and eastern States of America, after passing from the Rocky Mountains to Chicago in the last week of April. "It must be with the eastern and middle States as they say of Castile, *nueve meses del Invierno y tres del Infierno* (nine months of winter and three of hell). Winter is long and harsh; summer is brief and burning." Now, as a matter of fact, climate varies as widely in the eastern and middle States of America as it does in the eastern and middle countries of Europe, and in any section of any one of the eastern or middle States the weather differs as much from year to year as it does with us at home. But in those parts of the States where the contrast between the cold of winter and the heat of summer is most trying the average weather is by no means such that the inhabitants consider our English weather can possibly be better or even nearly as good. They know, indeed, as a rule, as much about our English weather as Mr. Froude knows about weather in America, having formed their ideas on just such evidence as he has had (and is now giving to the English public) in regard to American weather. But, in the main, they hold their weather to be much better than ours. The winter does not last nine months; often it does not begin before December, sometimes not till January, and it is often over by the middle of March. Summer, again, has usually two months of delightful weather, much like the best summer weather of England. Spring, indeed, is apt to last but a short time; but, on the other hand, autumn lasts much longer than with us; and the autumn weather of the middle and eastern States is usually charming, fully equal to our loveliest spring weather. The bitterness of the winter cold for occasional short spells is indeed trying, especially to those not accustomed to it. And there are sometimes summer days which might almost deserve to be called days *del Infierno*. But there are as many days of "London particular" in our metropolis; and, in its own way, a London fog is quite as suggestive of the infernal regions as a sweltering summer's day in Missouri. (For it should be remembered that, according to the opinion of the best authorities, the place of torment, though a scene of quenchless fire, is also, somehow, a place also of utter darkness: the heat of hell, in fact, would seem, from the account of those acquainted with its qualities, to belong to the ultra-red portion of the spectrum.)

Naturally, then, we reject Mr. Froude's very crude interpretation of American working energy. Americans "work as they do," he says, "because work alone can make life tolerable on such a soil, and in such a climate." Work is doubtless the true answer to the unmanly whine, "Is life worth living?"—but certainly there is nothing either in the soil or climate of the United States which should make life less enjoyable, when duly sweetened by manly toil, than it is in the old country.

Akin to Mr. Froude's absurdly hasty judgment on these wide general questions is his decision on matters of detail. On his way from Denver to Chicago he crossed the Missouri and the Mississippi, probably at Omaha and Rock Island, respectively—though, for anything "Oceana" says, it may have been at Kansas City and Quincy that he crossed the "big rivers." Yet he considers himself justified from this comparatively slight acquaintance with these grand rivers, and a few minutes' experience even of their aspect at one place along each, to tell his readers all about them. He has already pronounced a verdict against American scenery, having seen only a narrow strip selected for its flatness; he has decided that the forest trees are small and insignificant, having seen them only in places where the largest had long since been cut down; and then he goes on to deal with the great rivers. "The rivers!" he says. "Yes, the Missouri and the Mississippi are grand rivers, if bigness makes grandeur. The mighty volume of their water rolls on, carrying with it the rainfall of an enormous continent; but their turbid and yellow streams, fringed with unwholesome pine swamps, suggest only to the imagination that they are gigantic drains." It was an English physicist who spoke of the Thames as a great sewer, and *he* was hardly thought to have done full justice to the river whose graceful stretches past Richmond and Twickenham, and by Henley, Maidenhead, and Kingston, our poets have sung and our oarsmen love; yet Faraday at least knew thoroughly how far the Thames fulfils the office he assigned to it. Every river, inasmuch as its drains a country or a continent, is a more or less gigantic drain; and most rivers which flow through great cities are partly also sewers; but passing once across the Missouri and once across the Mississippi no more justifies a traveller in speaking of these great rivers as exceptionally drain-like in character, than reading a page of Mr. Froude's "Oceana" would justify us in saying that the book contains nothing but hasty judgments and unsatisfactory opinions.

There is, indeed, much in "Oceana" to interest those "who want to be entertained without feeling that they are losing their time." The account of the inland travelling in the northern island of New Zealand is interesting and in parts amusing, though scientific knowledge is not greatly increased by anything said or suggested respecting the marvellous white and pink terraces. The description of Mr. Froude's visits to Victoria and New South Wales is wanting in fulness, but some of the details are worth reading. The following extract from this portion of "Oceana" may be taken as a fair sample of Mr. Froude's manner; it relates also to an important Australian success:—

"While we were resting at Mount Macedon, Mr. Gillies had arranged another expedition for us to see a vineyard at a place called St. Hubert's, where the only entirely successful attempt to grow fine Australian wine had been carried out, after many difficulties, by Mr. Castella, a Swiss Catholic gentleman from Neufchatel. The visit was to be partly on our account that we might see what Victorian energy could do besides raising gold. It was also official, for Sir Henry Loch was to go with us as a recognition of Mr. Castella's merits to the colony. Australian wines had failed hitherto, as they had failed at the Cape, either from excess of sugar in the grapes, or from an earthy flavour contracted from the soil. The hock which we had tasted at Adelaide had been palatable but commonplace. Only experiments protracted through generations can determine in what situations wine

deserving the name can be produced. The flavour of a grape tells you nothing of the final flavour of the fermented juices. The same vines grown in two adjoining fields where the stratification or the aspect is different yield completely different results. The wine, too, must be kept for several years before the flavour into which it will ripen is defined. The best, therefore, which can be obtained in a new country is tentative and imperfect. Mr. Castella, however, had received honourable recognition from the best European authorities at the Sydney Exhibition for his hocks and clarets. The Governor was to go over his manufactory and congratulate him on his triumph. St. Hubert's was fifty miles from Melbourne in the valley of the Yarra. The blue satin railway carriage took us to the nearest station. There we clambered upon an old fashioned four-horse coach, and after a dusty drive of eight miles we reached a large roomy, straggling house, built with attempts at ornamental architecture, high-gabled roofs, a central tower with a flying outside staircase and gallery, the inevitable deep verandahs, and, as Mr. Castella's guests were often numerous, detached rooms, run up with planks, scattered in the shrubberies. The Yarra wound invisibly between deep banks across the plains in front of the windows. Behind it, far off, was a high range of mountains, from which columns of smoke were rising in half a dozen directions from forest bush fires, either lighted on purpose to clear the ground, or the careless work of wood-cutters or wandering natives. The fields immediately adjoining were the most brilliant green. The vines were all in full leaf. There were three hundred acres of them standing in rows, and staked like raspberry bushes, each bush powdered with sulphur, and smelling strongly of it. Our host himself was a vigorous, hale-looking man of sixty or upwards, with lively French features, light grey, merry eyes, with a touch of melancholy at the bottom of them—to be recognised at once as an original person well worth attention. . . . We were walked over the estate under our umbrellas, for the sun was blazing down upon us. We saw the vines growing, the presses, the rows of hogsheads in the cellars, the vats in which the grapes were trodden. I learnt here, as a fact new to me, that if fine wine is wanted, the human foot is still in requisition. Machinery crushes the grape-stone, and taints the flavour." [One would say that a suitable material could be produced which should give the same quality of pressure as the human foot supplies.] "We had to taste from various casks, and profess to appreciate the differences, which we none of us could," [We venture to question whether Mr. Castella really required his visitors thus to "say the thing which was not."] "for the palates of the uninitiated soon lose the power to discriminate."

We quote no more, but the whole account of this visit is very interesting—especially so to us, perhaps, because we had already heard so much from a kinsman of Mr. Castella's respecting that gentleman's success at St. Hubert's. Our author's sketch of Mr. Castella's partner, Mr. Rowan, a relative of Hamilton Rowan, with his anecdotes of Smith O'Brien's rebellion, including a battle in Ulster in which five hundred Catholics were killed, but of which history has hitherto declined to leave any records, is amusing. We hope it is a little more trustworthy than the account of a certain American host, who came out upon Mr. Froude with a saying about Niagara which Mr. Froude regards as new, but which has been repeated, to our personal knowledge, for at least a quarter of a century as an ancient jest, the remark, namely, that the falling of water over a precipice is nothing wonderful, "the wonder would be if the water did *not* fall." Mr. Froude seems, indeed, to have been unfortunate in being made the victim of several stories such as Americans keep for *gobemouches*. He may have seen "a mansion travelling without the help of an Aladdin's lamp"; but it assuredly does not quite so commonly happen as his account would imply that, "if a house is placed inconveniently, they lift it on rollers, and move it bodily from one place to another, while the occupants sleep and eat and go on with their employments as if nothing were happening."

Mr. Froude's touches at science are amusingly weak. He mixes with remarks on observations made at Melbourne by that faithful worker, Mr. Ellery, remarks on the contradictions of science, seeing that "he had read in a French scientific journal how the earth's axis had once been at right angles to the ecliptic, whence it had slowly inclined, as we see a spinning-top incline, till it had reached an angle of 45° or more, and was now half-way back to the perpendicular." We shall hear next that Mr. Hampden's absurdities, because they may have been mentioned in a scientific journal, indicate the helplessly unsatisfactory state of astronomy. "How many times," maunders Mr. Froude (really we can use no more respectful expression), "must we outsiders learn up our science, and then unlearn it? Each new generation of philosophers laughs at the conclusions of its predecessors." Considering the respect with which the most advanced astronomer of to-day traces the progress of astronomy from the time of Galileo to our own, nay the esteem in which the labours of Hipparchus and Ptolemy are held (even their misapprehensions being by no means ridiculed), these sayings of our author's would be altogether unjustified, even though suggested by real discoveries. As relating to a preposterous paradox such as only a man altogether ignorant of dynamical laws could have imagined they appear particularly preposterous.

Mr. Froude suggests that the heavy eastward winds of high latitudes may counteract the retarding influence of the westward flow of the tidal wave on the earth's rotation. Such a suggestion might do very well for the author of the paradox about the earth's axial pose, for it implies the same sort of ignorance of mechanical laws. Eastward winds can only exist as counterbalancing westward ones, and action and reaction being always equal, there can be no slightest trace of eastward beyond westward tendency in atmospheric movements.

"Oceana," however, despite these defects, is a book well worth reading by those who would form an idea of the widespread influence and of the rapid growth of the English-speaking communities. Not perhaps quite consciously, Mr. Froude does much in this volume to show how shallow and semisavage is the imperial idea of England's place in the world's history, how noble and worthy on the contrary her position as the mother of great nations of the future.

ETNA'S ERUPTIONS.

(*Continued from p.* 301.)

THE eruption of 1819 was in some respects even more remarkable than that of 1811. The Val del Bove, which, as already mentioned, breaks in upon the dome of Etna upon the eastern side, was covered by a sea of burning lava. Three large caverns had opened not far from the fissures, out of which the lava had flowed in 1811; and from these, flames, smoke, red-hot cinders, and sand were flung out with singular impetuosity. Presently another cavern opened lower down, but still no lava flowed from the mountain. At length a fifth opening formed, yet lower, and from this a torrent of lava poured out, which spread over the whole

width of the Val del Bove, and flowed no less than four miles in the first two days. This torrent of lava was soon after enlarged by the accession of enormous streams of burning matter flowing from the three caverns which had formed in the first instance. The river of lava at length reached the head of the Colonna Valley, where there is a vast and almost vertical precipice, over which the lava streamed in a cataract of fire. But there was a peculiarity about the falling lava which gave to the scene a strange and awful character. As the burning cascade rushed down, it became hardened through the cooling effects due to its contact with the rocky face of the precipice. Thus, the matter which had flowed over the head of the valley like a river of fire fell at the foot of the precipice in the form of solid masses of rock. The crash with which the falling crags struck the bottom of the valley is described as inconceivably awful. At first, indeed, the Catanians feared that a new eruption had burst out in that part of the mountain, since the air was filled with clouds of dust, produced by the abrasion of the face of the precipice as the hardened masses swept over it.

The length of time during which the lava of 1819 continued to flow down the slopes of the great valleys is well worth noticing. Mr. Scrope saw the current advancing at the rate of a yard per hour nine months after the occurrence of the eruption. The mode of its advance was remarkable. As the mass slowly pushed its way onward, the lower portions were arrested by the resistance of the ground, and thus the upper part would first protrude itself, and then, being unsupported, would fall over. The fallen mass would then in its turn be covered by a mass of more liquid lava, which poured over it from above. And thus "the current had all the appearance of a huge heap of rough and large cinders rolling over and over upon itself by the effect of an extremely slow propulsion from behind. The contraction of the crust as it solidified, and the friction of the scoriform cakes against one another, produced a crackling sound. Within the crevices a dull red heat might be seen by night, and vapour issuing in considerable quantity was visible by day."

The circumstance that Etna uprears its head high above the limit of perpetual snow has a remarkable bearing on the characteristics of this volcano. The peculiarity is touched on by Pindar in the words already quoted, in which he speaks of Etna as "the nurse of everlasting frost concealing within deep caverns the fountains of unapproachable fire." It will be readily conceived that the action of molten lava upon the enormous masses of snow which lie upon the upper part of the mountain must be calculated to produce —under special circumstances—the most remarkable and, unfortunately, the most disastrous effects. It does not always happen that fire and ice are thus brought into dangerous contact. But records are not wanting of catastrophes produced in this way. In 1755, for example, a tremendous flood was occasioned by the flow of the two streams of lava from the highest crater. The whole mountain was at the time (March 2) covered with snow, and the torrent of lava formed by the union of the two streams was no less than three miles in width. The flow of such a mass of molten fire as this over the accumulated snows of the past winter led to most disastrous consequences. "A frightful inundation resulted," says Sir Charles Lyell, "which devastated the sides of the mountain for eight miles in length, and afterwards covered the lower flanks of Etna (where they were less steep), together with the plains near the sea, with great deposits of sand, scoriæ, and blocks of lava."

In connection with this part of the subject may be mentioned the singular and apparently paradoxical circumstance that in 1828 a large mass of ice was found, which had been preserved for many years from melting by the fact that a current of red-hot lava had flowed over it. We might doubt the occurrence of so strange an event, were it not that the fact is vouched for by Sir Charles Lyell, who visited the spot where the ice had been discovered. He thus relates the circumstances of the discovery:—"The extraordinary heat experienced in the south of Europe, during the summer and autumn in 1828, caused the supplies of snow and ice which had been preserved in the spring of that year for the use of Catania, and the adjoining parts of Sicily, and the island of Malta, to fail entirely. Great distress was consequently felt for want of a commodity regarded in those countries as one of the necessaries of life rather than an article of luxury, and the abundance of which contributes in some of the larger cities to the salubrity of the water and the general health of the community. The magistrates of Catania applied to Signor Gemmelaro, in the hope that his local knowledge of Etna might enable him to point out some crevice or natural grotto on the mountain where drift snow was still preserved. Nor were they disappointed, for he had long suspected that a small mass of perennial ice at the foot of the highest cone was part of a large continuous glacier covered by a lava current. Having procured a large body of workmen, he quarried into this ice, and proved the superposition of the lava for several hundred yards, so as completely to satisfy himself that nothing but the subsequent flowing of the lava over the ice could account for the position of the glacier" (in other words, the ice had not accumulated in a cavern of moderate extent accidentally formed beneath overhanging lava masses). "Unfortunately for the geologist," adds Lyell, "the ice was so extremely hard, and the excavation so expensive, that there is no probability of the operations being renewed."

This strange phenomenon is explained, in all likelihood, by the fact that the drift of snow over which the lava flowed had become covered with a layer of volcanic sand before the descent of the molten matter. The effect of sand in resisting the passage of heat is well known. Nasmyth, the inventor of the steam-hammer, illustrated this property in a remarkable manner, by pouring eight tons of molten iron into a cauldron one-fourth of an inch thick, lined with a layer of sand and clay somewhat more than half an inch thick. When the fused metal had been twenty minutes in the cauldron the outside was still so cool that the palm of the hand could be applied to it without inconvenience. And lava consolidates so quickly that there must soon have been formed over the snow a solid covering, strong enough to resist the effects of the fresh molten matter which was continually streaming over it. In this way we may readily conceive, as Sir Charles Lyell has remarked, that a glacier 10,000 feet above the sea-level would endure as long as the snows of Mont Blanc, unless heated by volcanic heat from below.

It is worthy of notice that in the Antarctic seas there is an island called Deception Island, which is almost entirely composed, according to the authority of Lieut. Kendall, of alternate layers of ice and volcanic ashes.

One of the most perplexing subjects to geologists is the existence of so remarkable a valley as the Val del Bove, breaking the contour of the dome of Etna nearly to the summit. It must be remembered that there are few subjects which have been more carefully examined than the question of the formation of valleys and ravines. The primary agent recognised by geologists is the action of subterranean forces in upheaving and depressing the land. In this way, doubtless, all the principal valleys have been formed. But fluviatile influences have also to be considered; and a valley which exists upon the flank of a

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mountain may, in nearly every instance, be ascribed to the action of running water.

In the case of the Val del Bove, however, we are forced to come to a different conclusion. If this valley had been formed by the action of running water in some long-past era of the mountain's history, the chasm would have deepened as it approached the base. On the contrary, the precipices which bound the Val del Bove are loftiest at the upper extremity, and gradually diminish in height as we approach the lower regions of the mountain.

Nor can we imagine that the valley has been formed by a landslip. The dimensions of the depression are altogether too great for such an explanation to be available. And, passing over this circumstance, we are met by the consideration that, if the land which once filled this valley had "slipped" (in the ordinary sense of the term), we should see the traces of the movement, and be able to detect the existence of the removed mass. Not only is there no evidence of a motion of this sort, but the slightest examination of the valley at once disposes of the supposition that such a motion can at any time have taken place.

It remains only that we suppose the valley to have been caused by the bodily subsidence of the whole mass which had formerly filled up what is now wanting to the dome-shaped figure of the mountain. And the subsidence must have taken place in a sudden manner—not necessarily in a single shock, but certainly not by a slow process of sinking. For the mass which has sunk is sharply separated from the rest, so that the precipitous walls of the valley exhibit the structure of the mountain's frame to a depth of from 3,000 to 4,000 feet below the summit of the cone. In other words, a portion of the crust has been separated from the rest, and has then sunk bodily down, leaving the remainder unchanged.

When we consider the dimensions of the valley, such an event becomes very startling. "The Val del Bove," says Lyell, "is a vast amphitheatre, four or five miles in diameter, surrounded by nearly vertical precipices." One might almost be prepared to doubt that such a valley as this could be formed in the manner described, were it not that within recent times we have had evidence of the occurrence of similar events. During a violent earthquake and volcanic eruption which took place in Java in 1822, the face of the mountain Galongoon was totally changed, "its summits broken down, and one side, which had been covered with trees, became an enormous gulf in the form of a semicircle. This cavity was about midway between the summit and the plain, and surrounded by steep rocks." Yet more remarkable was the great subsidence which took place in the year 1772 on Papendayang, the largest volcano in the island of Java. On that occasion, "an extent of ground fifteen miles in length and six in breadth, covered by no less than forty villages, was engulfed, and the cone of the mountain lost 4,000 feet of its height."

There is nothing unreasonable, therefore, in supposing that some such event may have resulted in the formation of the strange valley which mars the dome-shaped figure of Mount Etna, although no such events have been witnessed in the neighbourhood in recent times.

One singular feature of the valley remains to be mentioned. The vertical face of the precipices which bound it are broken by what, at a distant view, appear to be dark buttresses, strangely diversified in figure, and of tremendous altitude. On a closer inspection, however, these strange objects are seen to be composed of lava jutting out through the face of the cliffs. Being composed of harder materials than the cliffs, they waste away less rapidly, and thus it is that they are seen to stand out like buttresses. Now, we would invite the close attention of the reader to this part of our subject, because, as it seems to us, it illustrates in a singularly interesting manner the mode in which volcanic cones are affected during eruption.

We have seen that in the eruption of 1811 there was evidence of a perpendicular rent having taken place in the internal framework of Etna, and in 1669 a fissure was formed which extended right through the outer crust. In one case lava was forced through the rent, and burst out at the side of the mountain. In the other, the brilliant light which was emitted indicated the presence of molten lava deep down in the fissure. Now, when we combine these circumstances with the *dykes* seen in the Val del Bove, and with the similar appearances seen round the ancient crater of Vesuvius, we can come, as it appears to me, to but one conclusion. Before and during an eruption, the lava which is seeking for exit must be forced with such tremendous energy against the internal framework of the mountain's dome as to fracture and rend the crust, either in one or two enormous fissures or in a multitude of smaller ones. It does not follow that all or any of the fissures would be visible, because the outer surfaces of the crust may not be rent. Into the fissures thus formed the lava is forced by the pressure from below, and, there solidifying, the crust of the dome remains as strong, after the liquid lava has sunk to its usual level, as it was before the eruption. When we see dykes situated as in the Val del Bove, we learn that the fissures caused by the pressure of the lava extend far down the flanks of a volcanic mountain. That they are numerous is evidenced by the fact that those seen in the Val del Bove amount, according to Sir Charles Lyell, to "thousands in number."

And perhaps we may understand from such considerations as these the manner in which the Val del Bove itself was formed. For a wide strip of country between two great fissures might be so waved and shaken by the action of the sea of molten lava beneath as to be fractured crosswise; and then, on the subsidence of the lava, the whole mass below the fracture would sink down bodily. We gain an extended conception of the energy of the forces which are at work during volcanic eruptions, when we see that they thus have power to rend the whole framework of a mountain.

Among recent eruptions of Mount Etna, one of the most singular was that of the year 1852, which began so suddenly that a party of Englishmen, who were ascending the mountain, and had nearly reached the foot of the highest cone, were only able to escape with great difficulty. The eruption which had commenced so abruptly did not cease with corresponding rapidity, but continued with but few slight intermissions for fully nine months.

In the last week of May, 1879, a fissure opened on the north side of the mountain, and volumes of smoke and flame were seen to issue from it. From the crater itself a great cloud of black ashes was poured forth, "rendering the mountain invisible," said one writer, "and obscuring the rays of the sun" (by which the writer presumably meant obstructing their passage), "even at a distance of many miles. These ashes were carried far and wide, and even covered the ground as far away as Reggio, on the adjacent coast of Calabria. Three new craters opened in the direction of Randazzo, on the north side of the mountain, and the lava ran rapidly towards the town of Francavilla, where great alarm was felt, though that town is situated beyond the river Alcantara, and on the very outskirts of the region usually threatened by eruptions. On the opposite side of the mountain, Palermo and the adjacent villa of Santa Maria di Licodia were also greatly alarmed." The new craters, and the fissure with which the eruption began, lay all on the northern side of the mountain. The stream of lava, which was estimated to be 70 mètres (about 75 yards)

in width, flowed in a direction somewhere between Francavilla and Randazzo, and reached the high road which encircles the mountain, and connects the latter town with the villages Linguaglosso and Piedimonte. These villages were enshrouded in a canopy of ashes, and almost total darkness prevailed in them. None of the ordinary concomitants of a great eruption were wanting. Balls of fire, or what were taken for such, were hurled into the air from the new craters and fissures, and, having reached a great height, they burst with a loud crash. Reports like the rolling of artillery were heard in the night, while night and day alike the stream of lava flowed stealthily and irresistibly on until it reached within a short distance of Linguaglossa.

The terrible but magnificent eruption of the present year tends to confirm the belief of geologists, that, if the earth's internal fires are diminishing in intensity, the diminution takes place very slowly. A process of change may be going on which will result one day in the cessation of all subterranean movements. But the rate at which such a process is going on is so slow at present as to be imperceptible. We cannot point to a time within the historical era, or even within that far wider range of duration which is covered by geological records, at which the earth's internal forces were decidedly superior in energy to those at present in action. Nor is this to be regarded as of evil import, but altogether the reverse. The work achieved by subterranean action, destructive though its immediate effects may often appear, is absolutely necessary to the welfare and happiness of the human race. It is to the reproductive energy of the earth's internal forces that we are indebted for the existence of continents and islands on which warm-blooded animals can live. "Had the primeval world been constructed as it now exists," says Sir John Herschel, "time enough has elapsed, and force enough directed to that end has been in activity, to have long ago destroyed every vestige of land." So that, raising our thoughts from present interests to the future fortunes of the human race, we may agree with Sir Charles Lyell that the most promising evidence of the permanence of the present order of things consists in the fact that the energy of subterranean movements is always uniform, when considered with reference to the whole of the earth's globe.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By EDWARD CLODD.

X.—EXISTING LIFE-FORMS.

B. *Animals* (continued). IV.—ANNULOSA.

THE common structural feature which gives its name to the numerous classes of animals, comprising four-fifths of existing species, grouped in this sub-kingdom, is the division of the body into more or less well-defined rings or segments. The nervous system consists of two fine cords knotted at different points by ganglia or masses of nerve-cells, the first pair of ganglia being above the gullet, so that the cords which join the second pair form a collar round it. The important part which the mouth plays as the immediate channel between the animal and its surroundings accounts for the development of the higher organs of communication near it; the anterior or front segments most completely undergo concretion, and in this way the portion that carries the mouth, the chief nervous centre or brain, and the sensory organs, as eyes, ears, antennæ, is formed. Hence the position of the head or skull, as the protecting structure around the more specialised parts, is ruled by the position of the mouth In the annulosa the nerves run along the belly; the heart, which is tube-shaped, lies along the back, and the digestive canal is between them. This arrangement of organs distinguishes all but the very lowest classes, both earth-worms and wasps, leeches and crabs, centipedes and beetles, lobsters and ants. But the advance in complexity of structure—in other words, in division of labour—is especially shown in the more elaborate arrangements for the conveyance of nutrition throughout the body as compared with that exhibited in the lower sub-kingdoms; *e.g.*, in the moneron, food and oxygen enter at any and every part; in the amœba, with its primitive skin, they are driven throughout the body by means of a pulsating vacuole; in the polyp, they are brought by the water which flushes it within and bathes it without; in the sea-urchin and the star-fish the nutriment is carried by the canals in their bodies which communicate direct with the water. But in the higher annulosa the oxygen and food are circulated by a more highly organised fluid called blood, which carries them to every part and likewise removes the waste and effete matter, the immediate motor power by which the blood is driven through the body being the heart, and the aëration of the blood—in other words, the supply of oxygen and the removal of carbonic acid—being effected by its passage through the respiratory organs. Only the back-boned animals breathe through the mouth, the lower animals breathing through pores or sacs in their sides.

The annulosa may be divided into the footless, comprising worms and leeches; and the footed, comprising crabs and other crustacea, spiders, scorpions, centipedes, and all insects. The jointed organs of locomotion known as limbs, and which have been developed from muscle-fibres, are arranged in pairs.

Among the lowest members of the annulosa, and with which almost all the higher animals are more or less connected in descent, are *Vermes* or *Worms*—these including a number of degraded forms which live as parasites inside the bodies of nearly all animals, man having his share of them; whilst among the humbler but highly organised and probably somewhat degraded classes are the minute *Rotifers* (so called from the wheel-like movements of the cilia round the mouth), which can remain for years in a state of suspended animation.

The typical form—head, thorax or chest, and abdomen or belly—of the numerous varieties of the widely diffused *Crustacea*, or hard-shelled class, whose three-lobed ancestors, the trilobites, flourished in the seas of the Cambrian and later periods, is the same, with infinite modifications in detail, as that of the remaining classes, from spiders to ants and beetles. But in *Insects* these three divisions are sharply marked, the chest, to which the legs and wings are attached, and the belly, being sometimes joined by a mere thread, whence the name given to that class—*insecta*, "cut into."

Like the rotifers, with their distinct nervous system, eyes, stomach, and other special organs, insects rebuke the vulgar notion that bigness is greatness, and that wonder is to be proportioned by the size of the thing which arouses it. For the infinitely small is as fully charged with mystery as the infinitely great; the movements of forces and energies in both cell and crystal are more complex than the motions of the giant bodies of the heavens; the ultimate analysis of the atom is more elusive than that of the mass which it makes up.

In the several states of existence, or metamorphosis, as it is called, through which most insects pass—egg, grub, chrysalis, imago; in the beauty and delicacy of their structure, notably in the wings, more perfect for flight than

those of birds; in the infinite division of organs, the spider spinning the six hundred strands of its web from as many teats; the dragon-fly with its twelve thousand eyes, each with its own lens and cone and rod; the caterpillar, with its fifteen hundred air-tubes; we learn that magnitude is not necessary to complexity. In the high nervous organisation of insects and the variety of functions, many of these quasi-human, which they discharge; in the dexterity of their actions, and the manifest adaptation of means to ends; in the social order of certain species, notably the ant-commonwealth with its division of labour, its slave and fighting population, its nurseries for pets and weaklings—a political and industrial order, which has not, like ours, to readjust itself by peaceful or bloody revolutions to changing conditions—we have striking evidence of the inter-relation of all things living, and of the unreality of the distinctions which man has set up between instinct and reason; in fine, evidence of fundamental correspondence between the nervous systems of the lowest and the highest. Complexity, not size; mental, not physical power, mark advance in the organism; and it is in the specialisation of the nervous system, and in the proportion of its controlling centre, the brain, to the rest of the structure, that the mechanical explanation of intelligence lies.* Mr. Darwin remarks that the brain of an ant, which is proportionally larger than that of any other insect, although itself not so large as the quarter of a small pin's head, "is one of the most marvellous atoms of matter in the world, perhaps more so than the brain of a man."

There is much force in the argument that the long period of infancy, with its consequent dependence on parental love and care, through which man, and in lesser degree the highest apes and other animals pass, has tended to develop the feeling of sympathy and its expression in service of the helpless by which the family is knit together, and out of which has grown the social instinct which forms tribes and nations. And the argument does not stop here. The more intelligent the animal the longer is the baby stage, for where there is a complex nervous system its specialisation goes on after birth; whereas in the case of an animal with low capacities all the nervous connexions are formed before birth, so that it begins life in lusty independence, fully equipped for work, and therefore with no tie to bind it to its parents, while its isolated life is fatal to mental development.

Now the ant, with other communal insects, as bees and wasps, has to pass through a relatively long grubhood, and in this we may have the explanation of its high social organisation, which has had measureless time for its development, since the remains of the hymenoptera are found as far back as the Jurassic age, *i.e.* the middle of the Secondary Epoch. And if the argument has any force in the case of man, the evolutionist is bound to apply it to the ant.

But in the highest members of the annulosa we arrive at the extremity of one branch of the life-tree, and we must descend to reach the starting-point which leads us to the loftier branch whose topmost twig is man.

V. Mollusca.—This sub-kingdom, the importance of whose fossil remains has been indicated, includes a wide range of organisms, any common definition of which is difficult. Many of them appear, like the fallen angels, not to have kept their first estate, as, *e.g.*, the lowest class, which resembles polyps and was formerly erroneously grouped with them. In the larger number of molluscs symmetry of form is more the exception than the rule, and, in one class, to be dealt with presently, we have the nearest known ally of the vertebrates.

Some of the mollusca have neither heads nor hearts, or at least quite imperfect ones, others have heads and chambered hearts; some grow together in colonies, others live an independent life; but all are alike soft-bodied, lacking the jointed structure which distinguishes the annulosa. Some, as the sea and land slugs, are naked, although furnished with a delicate shell when young; others have a leathery or gristly covering; the rest, the shell-fish proper, are protected by single or double valves, which in their spiral forms and fadeless colouring sometimes surpass the loveliest flowers, or which, as in the pearl-oyster, yield the lustrous substance which, according to ancient fable, is formed of raindrops falling into the open valve, where some mysterious agency transmuted them. The power of secreting matter from the surrounding water for the construction of their shells is one of the most persistent characteristics of living things, and in all the mollusca the shells (which are not cast periodically, as with the crustacea) are secreted along the surface of the thick flexible skin called the "mantle," the crumpled form of which determines their shape. They range in size from the enormous Tridacna of tropical seas, which sometimes weighs five hundred pounds, to the minute species of our coasts, thousands of which would scarcely exceed an ounce in weight.

The lowest molluscs are the plant-like, fixed *Sea-mats* and *Sea-mosses*; the highest are represented by the Briarean *Cuttlefish*, from the common species of our seas to the octopus with its rudimentary internal skeleton and its chameleon-like power to change its colour; and by the pearly *Nautilus*, the survivor of an ancient family that swarmed in the waters of the Jurassic and Cretacean periods. Between these range the more familiar shell-fish, notably the oyster, which, in common with all bivalves, is headless; and the periwinkle, whose land congener is the air-breathing snail.

But, for the evolutionist, interest in this sub-kingdom centres in the transparent bag-shaped *Sea-squirts*, or ascidians, which, although classed under Tunicata (Lat. *tunica*, a cloak), are entitled to a distinctive place. Most of the species are immobile, attaching themselves to rocks, shells and other objects, sometimes growing separately, sometimes in clusters on a common stem. Of the two openings in their gristly covering, which, by the way, is largely made up of cellulose, a characteristic element in plants, one is the mouth and the other the vent. The mouth opens into a breathing sac, furnished with numerous gill-slits and cilia, and leading through the gullet to the digestive organs—stomach and intestine—which are connected by a sharp bend with the vent, whence the inhaled water, after giving up its oxygen to the blood, is expelled. The heart, a tube-shaped organ, is placed at the lower end of the body-cavity which fills the space around the intestine, and the nervous system, consisting of a single ganglion, lies between the mouth and vent. The position of this ganglion, as will be seen later on, gives an important clue to the connexion between the ascidians and the vertebrates, but still more important evidence as to this is supplied in the early stages of the ascidian's development. In certain species the egg gives rise to a larva resembling the tadpole of a frog, both outwardly and inwardly, a resemblance "reaching absolute identity when we examine the way in which the various organs arise from the primitive egg-cell," the only important difference being that the ascidian has but one eye. The larva of the ascidian and the frog alike possess four structures which are common to every backboned animal at some stage of its development, and the possession of which is explicable only on the theory of the descent of sea-squirts and vertebrates from a common ancestor. These four structures are (1) the throat with its gill-slits; (2) the primitive backbone—a gristly rod called the notochord which is found in no invertebrates except the ascidians; (3) the brain and spinal cord; and

* The proportionate weight of brain to body is, in Fishes, 1 to 5,600; Reptiles, 1 to 1,300; Birds, 1 to 200; Mammals, 1 to 180.

(4) the eye, which is *inside* the brain. In all other animals which have eyes the retina or sensitive part is developed from the outer skin, and its outgrowth from the brain in vertebrates is ingeniously accounted for by Professor Ray Lankester on the theory that the original vertebrate was a transparent animal, through every part of whose clear skin the light passed and acted on the tissues of the inlying brain. But as the skin became tougher and denser, and functions consequently more localised, the eye-bearing part of the brain had to grow outwards till skin-vesicle and brain-vesicle met, and the eye was formed at the surface.

Similar as are the larvæ of the tadpole and the sea-squirt, they diverge at later stages. While the one advances from the fish-like form to the amphibian, exchanging gills and tail for lungs and limbs, and, in fine, epitomising in its development the series of forms through which its ancestors passed, the other fixes itself by the suckers on its head to stone or plant. Tail, notochord, nerve-cord, and eye disappear, the brain remains small, the throat enlarges, the gill-slits increase in number, the skin becomes hard and leathery, and the eyeless, footless thing sinks, as its manufacture of cellulose markedly shows, well-nigh to the plant level, its vegetating mode of nutrition sealing its degeneration.

The tailless amphibian frog and its allies are, however, not among the earliest vertebrates, which without doubt were aquatic, and the more complete evidence of the near relationship of the sea-squirt to them must be sought in comparison between it and the lowest known vertebrate, a small fish called the lancelet or amphioxus. This comparison will be made in the next chapter, with which our survey of past and present life-forms will end.

COAL.

By W. Mattieu Williams.

COMING now to the practical part of the subject—the business of coal-mining—the first step is to find the coal.

In those cases where the seam is known to exist, has been worked in the neighbourhood, this *may* be easy enough, though it does not always follow that it *must* be. I am sorry to be obliged to say that serious frauds are sometimes perpetrated by trading on the gullibility of investors, who are led to believe that because a seam of coal has been successfully worked in certain ground we will call A, and at another place a mile or two away which we will call C, that therefore the same seam exists in the intermediate ground B. This may be the case or it may not.

That it may be the case is obvious enough; that it may not demands some explanation. I have already described ordinary faults, where a down-throw or an up-throw compels the miner to seek for the lost seam either above or below the present workings, and which he finds by ascending or descending to a height or depth corresponding to the amount of displacement. But it must be remembered that coal-seams are usually more or less inclined from the horizontal, in some cases have been considerably tilted, and that a fault may be due to such tilting. It is easy to understand that such a tilting up-throw may expose the broken face of the coal-seam to the air, raise it above the general level of the surface at the time being, as part of an elevated ridge or hill. Subsequent denudation would cut away this elevated portion of the coal-seam altogether, leaving the lower continuation of the inclined strata still below, as well as the down-thrown portion on the other side of the fault. Thus in subsequent geological ages would be found a strip of land barren of coal corresponding with this denuded and reburied ridge, but with the coal-seam on both sides of it. This state of things is not at all uncommon in the much broken coal-fields of North Wales. Where it occurs the Welsh colliers say that "the coal has gone up to the sky," especially if the "farewell rock," the millstone grit, is exposed.

I describe this particularly in order to warn speculative investors against the fraud above alluded to. It is perpetrated by purchasing an old abandoned colliery and the land adjoining at its depreciated value, then issuing a prospectus describing the previous prosperity of the colliery, the quantity of coal formerly raised therefrom per acre, and the remaining acreage of unworked land. A company is "floated," the water pumped out from the old workings, new workings opened just where a little coal was purposely left near to the known fault, shares are run up, the projectors sell theirs, and presently the end of the remnant of coal is reached and described as an unexpected fault. In the worst cases another pit is sunk farther on beyond the fault, and thus the remaining capital of the new company is exhausted. The reopening of an old colliery should never be attempted without the most exhaustive inquiry into the reasons why it was abandoned, and the most convincing proof of the honesty of the experts employed to make the inquiry. An old hand whose name has appeared on the prospectus of previous failures should be especially mistrusted.

Readers may desire to know how a shrewd and honest adventurer, who has discovered, or thinks he has discovered, an unsuspected coal-seam, or a vein of metal ore, is able to turn his discovery to account when the land belongs to somebody else. Does he keep his discovery a secret and buy the land by a roundabout process, or under false pretences, or is there any fair and recognised mode of proceeding? There is, and it is as follows:—

He goes to the landlord, tells him that he has reason to believe that he can find workable coal or ore on a certain part of the landlord's estate, and will undertake the cost and risk of finding and working it on the usual conditions, these being that the landlord shall give the adventurer a "tack-note," or take-note, which is an agreement for a lease with exclusive right to work the minerals specified therein on the payment to the landlord of a certain *royalty* per ton of material raised. But the business of proving the coal, sinking the pit, and opening the workings occupies some time—two or three or more years—during which the adventurer and his associated capitalists are earning nothing for themselves nor for the landlord, but yet are operating upon the surface, doing it some damage as provided for the surface-rights included in the take-note. In order to hasten this preparatory stage and secure the interests of the landlord in case of abandonment of the enterprise, a specified amount of "dead-rent" is charged during this period, with a proviso that if the coal is finally worked the total amount of dead-rent that has been paid shall be credited against the first royalties, no cash for royalties being paid until they have amounted to the already paid dead-rent.

It sometimes happens that an illiterate poor collier is the discoverer or supposed discoverer of the unsuspected seam. He gets the take-note directly or by the aid of a friend, and in some cases sells it for a respectable sum. A case of this kind came under my notice in Flintshire; the take-note was first sold by the collier for 300*l.* to a man of means, who resold it to a wealthy company for 1,000*l.*, or thereabouts.

The mode of proving a coal-seam is first to sink a bore-

hole, carefully examining the material brought up by the boring tools. When I was concerned in such work the old-fashioned tools were used. These being merely "jumpers," or rude chisel-ended rods of iron, which were thumped down, then lifted, turned a little, and thumped down again, they made their way by simply pulverising the rock. The powder was removed at intervals by letting down a tube, dropping it several times until it picked up by wedging inside the pulverised material. This tube is named the "sludger," and it is obvious that a determination of the exact character of the rock by the examination of the powder or sludge is of very questionable reliability. A skilful expert can find almost any kind of rock he pleases, according to orders received. Now, however, the use of the diamond drill or auger has removed this uncertainty, solid cores of rock being brought up, by which the true nature of the strata can be safely identified at every stage. Even with the old boring tools and sludger actual coal could, of course, be distinguished.

Sanguine people sometimes sink a pit at once with full confidence that it must reach the coal. I watched the whole proceeding in one sad experience of this kind, where the pit came upon barren ground, denuded of the expected cannel seam, apparently by such a process as that above described, and subsequently covered up with more than one hundred yards depth of ordinary upper coal measures. As the cost of sinking and lining the pair of pits ran into thousands, the advantage of boring with modern appliances for obtaining demonstrative cores is obvious.

As a further illustration of the dangers of speculative mining, I may describe another case which occurred in the same neighbourhood. A good, honest, intelligent farmer, a tenant on the Leeswood estate in Flintshire, which nearly adjoins that of Hawarden, the scene of Mr. Gladstone's wood-cutting exploits, turned up in ploughing certain fields several lumps of curly cannel. This was in 1863, when there was great excitement in the neighbourhood owing to the extravagant price obtained for this curly cannel on account of its richness as a source of mineral oil. Instead of the ordinary price of coals, six or seven shillings per ton at the pit's mouth, this ran up to as high as thirty shillings. As one or two or three hundred tons per day is not an extravagant output, a net profit of one pound per ton was very tempting. I had just arrived in the neighbourhood; the farmer showed me some of the pieces of cannel he had turned up; there was no mistake about their composition. He obtained a take-note from his landlord, and was nearly ruined, spent his hard-earned savings in struggling to prove the coal-seam, which was not under any part of the farm, although more and more cannel was found in its soil.

I afterwards, during a residence of a few years in the neighbourhood, made a careful study of the details of its geological features, and discovered that the whole country around had been remarkably glaciated, all the lower levels being covered with moraine mounds, the upper denuded of its coal measures, and the millstone grit laid bare. I found great masses of limestone in railway cuttings and embankments many miles away from any limestone rocks, and great sandstone boulders, the subjects of curious legends, standing upon the cultivated soil, or partially buried therein.* The history of these was revealed by the striation and smoothing of one or more of their sides. (I read a paper on the subject to the Geological section of the British Association, 1865, an abstract of which is printed in their report.) When the Wrexham and Mold Railway was in course of construction, boulders of cannel were found in the Alyn valley near to Hope, and the workmen used them for their cooking fires. I succeeded in saving a fragment of one of these, and have it still. The nearest seam of cannel to the place where this was found is more than four miles distant, and between is the Hope Mountain, a mass of millstone grit rising 1,000 feet above sea-level and about 700 feet above the local valleys.

Had I known these facts earlier I might have saved the good farmer from the losses which broke him down. Possibly their publication in KNOWLEDGE may save others from similar disaster, as other minerals besides coal have been carried long distances down valleys, over plains, and across mountains by the great glaciers that formerly overspread so large a part of Europe. At any rate, such facts are interesting to all students of the history of our home planet. I am sufficiently irreverent and unlearned to believe that outdoor study of the moraine mounds upon which the trees of Hawarden Park are growing, and of the relations of these to the country around, would be a more healthful recreative study for an overworked statesman than the translating of overdone Homer.

Let us now suppose that a seam of coal is by careful boring fully proved on an estate which has never been worked for coal before, and that the whole estate is to be opened out for working.

The next step demanded is to ascertain the inclination of the seam. This, if corresponding to that of the strata above, is easily determined by what is known of them. To make sure of this, if doubtful, two or more borings may be made, and thus the supposed direction and inclination of the slope may be confirmed. I find that many people—in fact, most people who have not previously given attention to this subject—suppose that the part of the seam nearest to the surface, and the most easily reached, will be first attacked; but the contrary is the case. The very deepest part of the coal on the area to be worked is that to which the pits from which it is worked must, in ordinary cases, be sunk. The reason for this is simple enough.

Ordinary coal measures are water-bearing strata, and if the miner began at the upper part of an inclined seam, he would presently have to dive and to work under water; by beginning at the lower part and making a "sumph," that is, sinking his pit to some depth below the bottom of the seam he intends to work, the water runs down into the sumph, from which he pumps it, and thus the whole seam, so far as he is concerned, is drained for working. Besides this, the trollies that bring the coal to the bottom of the shaft all run down inclined roads when loaded, and up the inclines when empty.

I say "so far as he is concerned," and that he works from the deepest part of his own area, but where others own important parts of the seam above him the conditions become perplexing if there is much water and the cost of pumping is great. He must either pump away his neighbour's water as well as his own, or be "drowned out." The rational and equitable course to be followed in such cases is to pump from below by co-operation; but although man is described in biological classification as *homo sapiens*—as a rational and moral being—he does not always justify such description; and hence there are landlords even in England who leave the coal upon their estates unworked rather than subscribe their fair share towards co-operative drainage of the whole field, hoping that some neighbour lower down in the seam will do for them what the industrious and thrifty ratepayer does for the lazy, improvident, or incapable inmates of the union workhouse. These greedy would-be pauper landlords have,

* On the Ordnance map of Flintshire is the name "Garreglwyd" (the grey stones), near to Padeswood Station. Two very remarkable glaciated boulders of millstone grit, that have given this name to the farm, may there be seen standing in a field by the roadside.

however, done some service in checking the rapid exhaustion of our richest coal-fields.

I should add to the above that some coal-seams are dry. These are at present very rare, but will probably become more abundant hereafter, as we proceed deeper and deeper in search of coal. As all the water encountered in sinking coal-pits, wells, &c., is originally derived from the surface, being rain that has penetrated the earth's crust, there is a limit beyond which it does not reach—the which limit is determined by impermeability of strata due to compression and by the continually increasing temperature at increasing depths.

OPTICAL RECREATIONS.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

IN the series of papers which have appeared under the above heading in these columns we have endeavoured to explain popularly the nature and properties of light, the phenomena of reflection, refraction, interference, and dispersion, the way in which we see, and the source and origin of the innumerable colours which we behold around us. We have endeavoured to simplify our exposition of optical phenomena generally by detailed and illustrated descriptions of apparatus which may be made at home by the veriest beginner; and it now only remains for the editor of this journal to treat, as he has promised, of the spectroscope and its applications, to render these essays tolerably complete as an elementary introduction to the study of optics.

Our object, then, in this concluding chapter is to supplement what we have previously said by an account of two or three pieces of apparatus to which we omitted to refer in the proper places, but which seem calculated to throw a certain amount of light on those branches of the subject which they are especially designed to illustrate. On p. 278 of vol. vi. of KNOWLEDGE will be found a description of the action and construction of the stereoscope, and it is there shown how the images of a single object, when sufficiently near to the eyes, are decidedly different as seen by each of them. It is further shown that it is by the convergence of the eyes necessary to bring similar points (dissimilarly situated) into coalescence that the sensation of solidity is produced; that, in fact, in looking at any very distant object the optical axes of the eyeballs are parallel, and that as an object approaches the observer those axes must become more and more convergent. Now, the reader who has thoroughly grasped our explanation will, on a little reflection, see that just as in algebra we can transfer any quantity from one side of an equation to the other by merely changing its sign, so it may be (and, as a matter of fact, it is) possible so to present the two diverse images of a solid body to the eyes as to affect the observer with the belief that he is viewing a hollow one, and *vice versâ*. This is effected by the aid of a very simple instrument, much less known than it deserves to be, and which is known as the pseudoscope. It used to be exhibited at the now defunct Polytechnic Institution. It is represented in plan (or horizontal section) in the subjoined figure.

Here are shown at A and B two prisms placed against a block of wood, about two inches long and one and a half inch wide, cut out in the centre at D to admit the nose. The eyes are supposed to be looking at the globe C in the direction of the arrows. E, E, are brass-plates blackened, which shut out the side light and assist in keeping the prisms in position. A globe viewed through this simple apparatus presents, for a reason which should be now perfectly intelligible, the effect of a concave hemisphere; a hollow tea-cup, on the other hand, standing out as a globe. The effect is very startling, but it sometimes requires a certain amount of gazing to be produced. This pseudo-relief may also be observed by regarding the intaglio crest on a signet ring illuminated by side light, through a lens of an inch focus or so. Almost immediately the intaglio will apparently become a cameo, and the crest will stand up

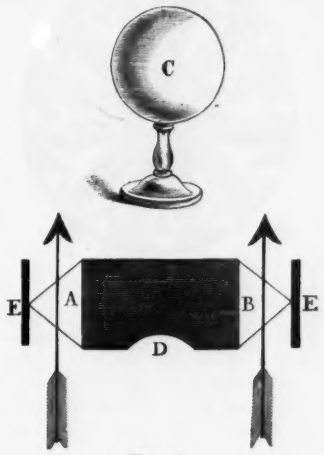

FIG. 1.

above the surface of the stone with startling distinctness. A cognate phenomenon often occurs in viewing lunar craters in a telescope furnished with a solar diagonal eyepiece, and armed with a tolerably high power, under which circumstances the craters put on the appearance of blisters on the face of the Moon, presenting an absurd effect.

In referring to the production of chromatic phenomena in vol. ii. and elsewhere, we omitted to describe two very simple experiments which exhibit them beautifully and effectively. For the first we are indebted to Sir John Herschel, who illustrated the action of minute refracting spheres by mounting the spores of the common puff-ball in a film of oil between two plates of glass. When this arrangement is held close to the eye, and a candle flame viewed through it, beautiful concentric haloes appear. The second little device was the invention of the late Rev. J. B. Reade, and was called by him the "iriscope." He took a circular plate of glass, painted one side of it black, and, after carefully cleaning the other side, rubbed it over with a piece of wet soap. This was, in turn, rubbed off with a clean soft duster. A tube, about half an inch in diameter and a foot long, was held about an inch from the centre of the soaped plate, and the observer blew gently down this tube. The result was that an immense number of minute particles of moisture were deposited on the glass, and these by inflection decomposed the light and produced all the colours of the spectrum.

Proceeding now to our description of Maxwell's discs, and the whirling table on p. 95 of the current volume, we may add that what is done by this piece of apparatus may be as easily effected by the so-called "Gorham's colour top"—a device of that well-known and most ingenious optical physicist, Mr. Gorham, of Tonbridge, whose "pupil photometer" was described on p. 465 of our sixth volume. This is, in fact, nothing more than a top made with a very heavy metal ring, like a gyroscope, on the face of which the Maxwell's discs are laid. By touching the edge of one of them as they rapidly rotate, a varying amount of each

coloured surface is exposed, with the result of notably altering the combined colour. Mr. Gorham also devised an adjunct of the utmost simplicity which gives very pretty results. It consists of a black circular card placed loosely on the stem of the top, above the combination of coloured discs, and having some regular pattern (such, for example, as that shown in fig. 2), cut or punched out of it. A piece

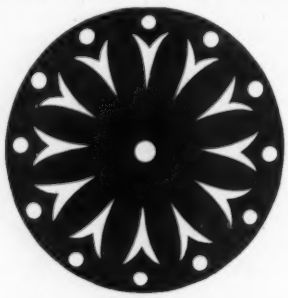

FIG. 2.

of string attached to the periphery of this disc checks its rotation, and causes it to proceed to a certain extent by fits and starts, with the result that the eye looking down upon the black disc sees the pattern beautifully diversified by the colours of the subjacent Maxwell's discs, both separately and in combination. Of course this arrangement can be adapted to the whirling table, too.

Another simple contrivance of Mr. Gorham's to a certain extent performs the work of the double-image prism described on p. 96. This consists of a common pill-box, with small holes pricked through the bottom of it, and covered with films of coloured gelatine. Another hole is pricked centrally in the lid through which the bottom perforations are viewed against a strong light, with the pretty obvious result of causing the diffused coloured discs (produced by viewing the holes at so very short a distance) largely to overlap, and so to exhibit the phenomena of superposed, or rather combined, coloured lights.

Here, then, we terminate our attempt to furnish the student with the means of grounding himself in the elements of physical optics by the aid of apparatus within the reach of everyone. It only now remains for the editor to commence that exposition of "Light-sifting," without which the subject would be left in but an incomplete state indeed.

A LAND OF COLDLESS COLD.—On the island of Chiloe, on the south-west coast of South America, they have 290 cold, rainy days in the year, four-fifths of the rain being mixed with sleet. Yet the natives of that remarkable clime enjoy an equally remarkable immunity from pulmonary disorders. Catarrhs are so nearly unknown that our current theories on the origin of "colds" seem in urgent need of a revision. The latter fact appears to have been recognised now and then. "I shall not attempt to explain," says Benjamin Franklin, "why damp clothes occasion colds rather than wet ones, because I doubt the fact. The cause of 'colds,' I believe, is totally independent of wetness, and even of cold."—*Dr. Felix L. Oswald.*

AN "EVERLASTING" GOOD SHOT.—Jo Brown, one of the Georgia senators, used to be the best shot with a squirrel rifle in the south. His father would give him twelve bullets and tell him to bring in twelve squirrels. "And mind ye," the old man would add, "let the holes be through their 'tarnal heads."

AMERICANISMS.

(*Alphabetically arranged.*)

BY RICHARD A. PROCTOR.

(*Continued from page* 276.)

Evening. In the South and West "evening" runs from noon to sunset, when night begins. It is probable that this is really the older usage. Noon, in fact, marks the evening or equalising of the part of the day passed and the part that is still to come.

Eventuate. To happen. Worcester says the word is "rarely" used by English writers, and Webster says it is "rare" in England. Is it *ever* used, except as slang, by English writers? I have never seen it. Walker does not mention it, not even as a bad word.

Everlasting, everlastingly. The use of these words as intensatives is peculiar to America, and probably, like many other of the profanities of the new country, had its origin in Puritan communities. Just as in many Catholic countries we find references to all that Catholics hold in special reverence used as the most convenient forms for swearing, so in New England, formerly, "tarnation" (for "damnation") was used for extra emphasis. And naturally the adjectives used by religious folk there in cheerful association with "damnation" came also to be favourites with the profane. Since damnation is to be eternal or everlasting, so "eternal" in the form "*tarnal*" was early recognised as a convenient expletive. "Everlasting" took a similar position. "America is an 'everlasting' great country"; "America whipped the Britishers to 'everlasting' smash"; "may I be everlastingly dog-goned," and so forth and so forth—everlastingly.

Every once in a while. Bartlett remarks that this is probably English. He might have written "certainly." "Once now and again" is another English form having the same meaning. The difference between the use of such forms in America and in England is simply in their standing. In England they are used only by the illiterate.

Excellency. A courtesy title given to governors of States. The constitution of Massachusetts allows the title—so that General Benjamin Butler, loved of New Orleans, would now be an Excellency if he had secured a majority over Robinson in 1883. Occasionally its use suggests the *quasi lucus d non lucendo* principle. However, there is probably about as much excellency in the average State governor in America as there is grace in an average duke, or majesty in ordinary kings and queens, or divinity in the kings and queens of two centuries ago.

Excursionist. Bartlett has this word as an Americanism, presumably because it is now used in America in precisely the sense which has long been given to the word in the old country.

Executive, The. Vide *Excursionist.*

Expect, To. Used like "guess," "reckon," "calculate." Webster is very severe on all such mistakes.

Experience. There is a religious use of this word which is, I sincerely trust, an Americanism pure and simple. When a preacher, professional or otherwise, says he is going to tell his "experience" he means that he is going to tell how he "got religion"—another slang expression, which, we may hope, is not English. Statistics tend to show that about nine out of ten who in this sense are ready to tell their "experience" end by getting more than religion, and about five of the nine have to get out. Retired prize-fighters, detected swindlers, repentant convicts, and used-up tipplers are special favourites (not always in America only) when "experiences" are to be related.

Experience Religion, To. To be converted; to discover that the profession of religion is good business. Many in America, as elsewhere, experience religion in the sense in which the man might be said to have experienced honesty, who said—'cutely, if not quite grammatically—"Honesty is the best policy; I say so, and I ought to know, for I've tried both."

Express. This word is always applied in America to the rapid conveyance of goods.

Express-man, Express-office, Express-wagon. Words connected with the express business, and needing no explanation.

Eye-opener. Generally anything which startles; anything which gives a lively expression to the countenance. Hence applied to a specially strong morning drink, the frequent use of which gives to the countenance a specially gloomy aspect.

Eyes, skinned. "To keep the eyes skinned" is a graceful way of expressing lively attention. Occasionally this elegant expression is altered by the substitution of "peeled" for "skinned."

Face the Music, To. Equivalent to the Americanism, "Stand the racket," and the English expression, "Come up to the scratch." Probably the exceeding atrocity of most American bands accounts for the special significance of the expression.

Fair and Square. See *Excursionist.*

Fair off and *Fair up.* Used for "clear off" and "clear up" in the south-western States, applied to the weather only.

Fair Shake. A fair bargain. Described by Bartlett as a "New England vulgarism."

Fall. A common mistake for "fell," as "to fall a tree" for "to fell a tree." Commoner, perhaps, in America than in England.

Fall, for "autumn." A word derived from the old country, but now, unfortunately, out of use among us. Fall and spring match far better than the Latin "autumn" with the Saxon "spring." Webster of old, however, and Annandale of to-day present the word "fall" as good English for autumn; and until Englishmen call spring *ver,* we may still hope that they will return to the good old English "fall."

Fan, Out. To come out (well) in examination. Bartlett thinks the expression derived from a peacock spreading out its tail. Far more probably it is derived from fanning, in the sense of winnowing.

Fancies. A term applied to stocks, the purchaser of which has no means whatever of rightly estimating their value. Used in stock gambling, a method of seeking ruin known outside the States.

INDIAN MYTHS.

BY "STELLA OCCIDENS."

WE have considered the Indian myths regarding the Great Bear. We may now turn our attention to the Little Bear and the Pole Star. The latter must have puzzled the observant Indian, for whilst the rest of the stars were continually shifting their position, this one star remained immovable. The stars were supposed to be animated beings, and as hunting was the usual occupation of the Indians, the stars were principally regarded as hunters. The constellation of the Great Bear represented hunters in pursuit of a bear; whilst the constellation of the Little Bear suggested another party of hunters, guided by the Pole Star. Among the Iroquois traditions is the following myth.

A large party of Indians, whilst in search of new hunting-grounds, wandered on for many moons, finding but little game. At last they arrived at the banks of a great river, entirely unknown to them, where they had to stop, not having the material to build boats. Lost, and nearly famished with hunger, the head chief was taken very ill, and it was decided to hold a council to devise means for returning to their homes. During the dance preceding the council, and while the tobacco was burning,* a little being like a child came to them, and said that she was sent to be their guide. Accordingly, they broke up their camp, and started with her that night. Preceding them with only a gi-wăh, or small war-club, she led them on until daylight, and then commanded them to rest, whilst she prepared their food. They slept, and when awakened by her they found a great feast in readiness for them. Then she bade them farewell, with the assurance of returning to them in the evening.

True to her word, at evening she reappeared, bringing with her a skin jug, from which she poured out some liquid into a horn cup, and bade them each to taste of it. At first they feared to do so, but at last yielding, they began to feel very strong. She then told them that they had a long journey to perform that night. Again they followed her, and in the early morning arrived at a great plain, where she bade them rest again for the day, with the exception of a few warriors, who were shown where they could find plenty of game. Two of the warriors had accompanied her but a short distance when they encountered a herd of deer, of which she bade them kill all they wished in her absence. Again, promising to return at night, she took leave of them. At nightfall she returned, saying her own chief would soon follow, to explain to them how they could reach their homes in safety. In a short time he arrived with a great number of his race, and immediately all held council together, and informed the Indians that they were now in the territory of the pigmies. The latter would teach them a sign already in the sky which would be a sure guide when they lost their way. The pigmies pointed out the Pole star, and told the hunters that in the north, where the sun never goes, while other stars moved about, this particular star would stand still, as a guide to the Indian in his wanderings. They were to follow its light, and they would soon return to their tribe, where they would find plenty of game, &c.

Then they thanked the good pigmies, and travelled every night, until they arrived home safely. When they told all their adventures, the head chief held a meeting of all the tribes, and they resolved to give the star a name. They called it Ti-yn-sōu-dă-go-êrr (the star which never moves), by which name it is known to this day.† Now, in the constellation of the Little Bear there are four stars apart, and three leading directly to the Pole star. The four stars apart were probably the hunters, and the three leading to the Pole star were the two hunters and the child. The pigmies are introduced in the myth because their mission is to help hunters, and we have already observed their close connection with the stars.

As the Indians had observed the stationary position of the Pole Star, so the disappearance for awhile of certain groups of stars attracted attention. Stars which were to be seen in the summer months were no longer visible in winter. The Indians could not account for their absence. In the Hiawatha legends, Schoolcraft relates a Shawnee legend, in which may be recognised a constellation myth.

* The fumes are supposed to ascend as prayers to the gods.

† Smithsonian Institute, "Myths of the Iroquois," p. 59, vol. 1880–81. The above myth is related by Mrs. Erminnie A. Smith, and is translated from the original language. She spent many years among the Iroquois tribes, into one of which, the Tuscarora, she was adopted.

XUM

The following is an abridged account of the myth of "The Star Family, or Celestial Sisters." *

Waupee, or White Hawk, was a great hunter. He was tall, and full of life and strength. One day whilst wandering through the forest he suddenly found himself on the borders of a prairie. It was covered with grass and flowers, and presently he noticed a ring worn through the grass without any path leading to or from it in any direction. He determined to hide himself behind some bushes and watch the place.

> Soon he heard, high in the heavens,
> Issuing from the feathery clouds,
> Sounds of music, quick descending,
> As if angels came in crowds.

Looking up he saw a small speck in the sky, which gradually became larger and larger. At last he saw a basket containing twelve beautiful maidens, who leaped out of the basket as soon as it touched the ground. They danced around in the ring, beating time on a silver ball, which made the beautiful music Waupee had heard. He gazed at the fairies in wonder, and at last rushed out from his hiding-place and tried to capture one of them. However, they were too nimble for him, and, leaping into the basket, they were soon on their way to the sky again.

Waupee was vexed, but next day he hid behind the bushes again, and disguised himself as an opossum. The sisters came down again as before; but one, sharper than the rest, saw the opossum creeping towards them. She warned her sisters, and they sprang into the basket, and were soon on their way to the sky. However, when they were half-way up, one of the sisters suggested that perhaps the opossum only wanted to show them how the ball-game was played on earth. "No," said the youngest, "quick, let us ascend."

Next day Waupee changed himself to a mouse, and seeing an old stump of a tree, he moved it near the magic circle, and hid himself inside. When the sisters came down next day, one wiser than the rest noticed the altered position of the stump; but the others, laughing at her, ran around the stump and struck it in fun. Waupee ran out and chased the youngest, whom he caught and carried off in triumph. The rest jumped into the basket, and returned to their home in the skies.

For awhile Waupee was very happy with his beautiful bride, and his joy was increased by the birth of a beautiful son. But his bride became very homesick, and one day when Waupee was out hunting she made a wicker basket, and, going to the magic ring, she got into the basket with her little son, and, singing the magic chant, she soon rejoined her sisters.

Waupee, hearing the music, looked up, and seeing his wife and child ascending in the air, he cried pitifully, and could not be consoled.

After a year had passed, the father of Waupee's bride said to her, "Go, my child, and take your son down to his father, and ask him to come and live with us. Tell him to bring a specimen of each kind of bird and animal he kills in the chase."

Waupee was overcome with joy to see her again, and, hearing her father's message, he hunted for many days. He kept a claw, foot, or wing of every species he captured, and ascending in the basket with his wife and child, he presented them to his father-in-law, the star chief. The latter invited all his people to a great feast, and bade them choose from the collection Waupee had made. As they chose a wing or a claw, they became animals and ran away. Waupee and his wife and child chose a white hawk's feather. Gracefully spreading out their white wings, they descended to earth, where the species are still to be found.*

This tribe of Indians possibly accounted in the above way for the disappearance of some constellation. It might have been the constellation Coma Berenices, which is visible during the summer months. It is composed of twelve stars —representing the twelve sisters—and is as much like a basket in shape as the Great Bear is like a bear. Or else the myth may refer to Corona Borealis, which bears a still greater resemblance to a basket during the month of June, though it has not the requisite number of stars. However, in the southern map for July in the editor's "Easy Star Lessons" the constellation resembles a basket, and includes twelve stars and an extra star, which may be Waupee.

* Smithsonian Institute, p. 67, 1881.

THE STAR-CLOUDS IN THE PLEIADES.

By RICHARD A. PROCTOR.

AMONG the arguments which I advanced seventeen years ago to show that the various forms of nebulæ or star-clouds visible with telescopic aid in the star-depths belong to our own stellar system, none seemed to me more convincing than the way in which stars and nebulous matter are intermixed in the same region of the heavens.

The association between the stars of our system and the nebulæ long regarded as external universes is shown "most

FIG. 1.—MAP OF THE PLEIADES BY TEMPEL, SHOWING THE NEBULA EXTENDING FROM MEROPE, &c.

strikingly," I said in my "Other Worlds," "by the obvious connection between the figure of the irregular nebulæ and the arrangement of the star-groups seen in the same field of view. There is not one of the irregular nebulæ which does not exhibit this peculiarity in the most striking manner.

* Schoolcraft, "Hiawatha Legends," p. 116.

This may be asserted even of those nebulæ with respect to which Sir John Herschel has remarked that the arrangement may be accidental. His own pictures seem to me to prove in the most convincing manner that no such explanation can be accepted. The mere aggregation of a large number of stars in the very heart of a nebula might be an accident; the fact, for instance, that the great irregular nebula surrounding the star Eta Argûs agrees exactly in position with the greatest condensation of the wonderfully rich portion of the Milky Way on which that surprising variable lies, might be a mere coincidence, though in any case it would be a strange one. But when one examines the structure of this and similar nebulæ, and finds that the stars are arranged in a manner most obviously related to the arrangement of the nebular condensations—or folds, one may almost say—one cannot doubt that a real and intimate bond of association exists between the stars and the nebulous masses around them. If the extension of the milky light of the great Orion nebula to the star ι in the sword, which is centrally involved in strong nebulosity; to ε in the belt which is similarly involved; and to several other stars in the constellation, all alike in occupying regions of increased nebular condensation—if this be a mere accidental coincidence, then the laws of probability had better be forgotten as soon as possible, for, as at present understood, they can only serve to lead men astray."

"Amongst other instances," I went on, after referring to illustrations of large nebulæ, "may be cited the nebula round the stars c^1 and c^2 in Orion. In this object two remarkable nebulous nodules centrally surround two double stars. Admitting the association here to be real, and no other explanation can reasonably be admitted, we are led to interesting conclusions respecting the whole of that nebulous region which surrounds the sword of Orion. We become certain that the other nebulæ in that region are really associated with the fixed stars there; that it is not a mere coincidence, for instance, that the middle star in the belt of Orion is involved in nebula, or that the lowest star is similarly circumstanced. It is a legitimate inference from the evidence that all the nebulæ in this region belong to one great nebulous group which extends its branches to these stars. As a mighty hand this nebulous region seems to gather the stars here into close association, showing us in a way there is no misinterpreting that these stars and the nebulæ form one system."

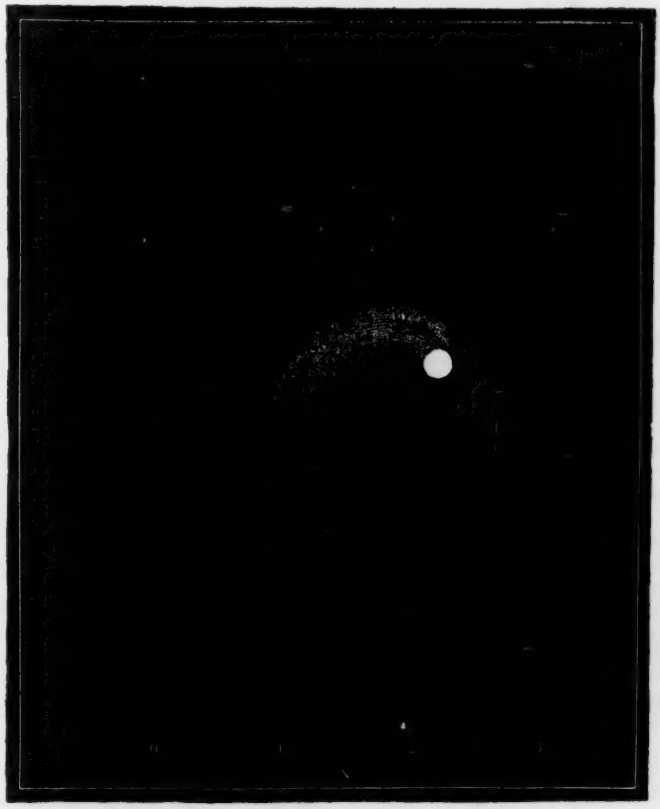

FIG. 2.—THE NEBULA EXTENDING FROM MAIA IN THE PLEIADES.
Enlarged from the Photograph.

I would invite the astronomical readers of KNOWLEDGE to study the photograph of the Pleiades in the June number, comparing it with Tempel's map of the Pleiades (fig. 1 of the present number), and Wolff's chart (fig. 1 of the June number), in connection with the above remarks. We find in the photograph the evidence of the unbiassed eye of photography to show that the nebulous matter in the Pleiades is really associated with certain of the stars in this remarkable star-group. In fig. 2 is shown an enlargement of the nebula, extending from Maia of the Pleiades (see the small chart, fig. 3, in June number, and compare with Tempel's chart, in which Maia appears as Maja).

If anyone looking at these several drawings, considering

the evidence above adduced with regard to the Orion nebula and the nebula in Sagittarius, and further considering the evidence given by the Andromeda nebula recently, and the Argo nebula long since, should retain the opinion that the nebulæ are external star-clouds only seen by accident in optical connection with much nearer stars belonging to our galaxy, there can be nothing to prevent him from rejoicing in such an idea. Certainly no evidence could have any influence in that direction. He could not be convinced though "one rose from the dead," seeing that the orbs of heaven would have spoken in vain for him. Inaptitude such as this for appreciating evidence might not prevent him from being a fairly good astronomer of the surveying sort. But the philosophy of astronomy must ever remain a sealed book to him.

THREE PUZZLES.

(See last Number.)

I. *To arrange nineteen trees, so that they may form nine rows, five in each.*

MARK out the ground as follows:—Let A, D, B, F, C, E, fig. 1, be the angles of a regular hexagon. Join AB, BC, CA, DE, EF, ED, and also DC, AF, EB, intersecting in one point, O. Then if a tree be set at each of the points where the nine lines thus drawn intersect, viz., at A, D, B, F, C, E, at G, H, K, L, M, N, at O, and at P, Q, R, S, T, U, there will be five trees on each line, or nine rows of five trees in each.

The hexagon need not be regular, nor need the figure be in any way symmetrical. But the farmer would naturally prefer to have his ground neatly plotted out.

This puzzle may be extended as follows:—Let C, A, D, B, E be the angles of a regular figure, having $2n$ sides; draw AB and CD, DE cutting, and cutting AB in F and G. Then let straight lines be drawn from C, A, D, B, E to O, the centre of the circumscribing circle (as in fig. 1). This being done from every such angle, as at D, A, B, C, E, &c., it is evident

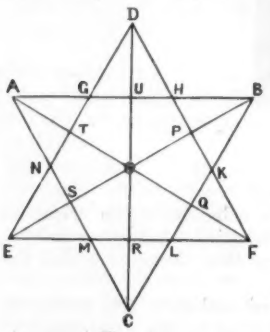

FIG. 1.

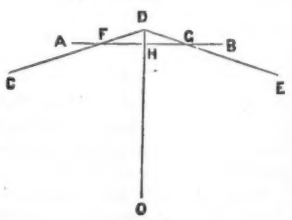

FIG. 2.

that on every such side as AB, DC, CE, &c., there be will be five intersections, and on every line through the centre *four* (for the lines to the centre will give straight lines through the centre), so that the centre itself will make a fifth point precisely as in fig. 1).

Now let us see how many rows of five trees will be formed if a tree is put at each intersection, besides a tree at O; and how many trees will be required:

(1) There are $2n$ sides, and n lines through the centre; that is, there are $3n$ rows in all.

(2) Counting the trees in triplets (as thus in fig. 1—D, H, G; A, T, N; &c.), we see that there are $2n$ triplets; or adding the central tree, the total number of trees is found to be $6n+1$.

Thus the general problem is:

Given $6n+1$ trees it is required to arrange them in $3n$ rows, 5 in each row. (But n must not be less than 3.)

The solution for the general case is indicated in fig. 2.

For the general problem regular figures are not actually required but make a better show than irregular ones, which also cannot be drawn casually. We know that straight lines drawn from the angles of a regular figure of an even number of sides inscribed in a circle will pass severally through the opposite angles. But lines connecting opposite angles (as in fig. 1) of a polygon with an even number of sides will not intersect in a point unless the polygon is either regular, or has its angles set on lines drawn through one point.

The best regular arrangements are obtained from figures inscribed either in a circle or an ellipse. It is only thus that this particular puzzle is associated with the ellipse.

II. *To divide a rectangle (or, if preferred, a parallelogram) into two parts which shall fit so as to form another rectangle.*

We prefer taking the general problem here, showing the limits within which solution is possible.

Let ABCD (fig. 3) be the parallelogram.

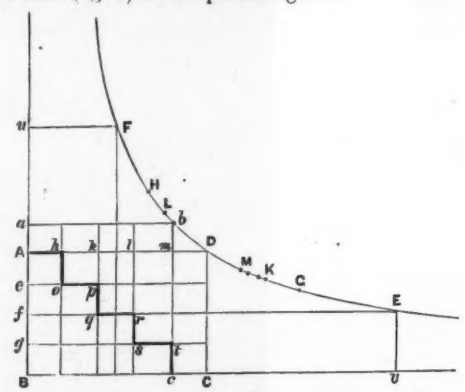

FIG. 3.

Divide AB into any number of equal parts—say, four—at the points *e f g*; and divide AD into equal parts, one more in number—or in this case five—at the points *hklm*. By parallels through these points to the sides AB, AD, divide ABCD into equal parallelograms, as shown in the figure. Let ABCD be then divided into parts along the zigzag line *hopqrstc*, and let the portion on the right of this line be shifted to the position A*bs*, as shown in the figure. Then will these two portions form a parallelogram, B*b*.

This puzzle is worth examining geometrically.

It is obvious that the longest parallelogram which can be formed out of AD is obtained by dividing AC into two halves by a line parallel to its longest sides. The parallelogram BE, thus formed, will have its angle at E, where *f* E is twice BC.

Similarly the longest parallelogram in direction BA will be BF, where B*u* = 2BA and BC = 2*u*F.

The next longest either way will have angles at G and H, two-thirds of AB and BC from BC and AB respectively, and *one-half* further than D from BA and BC respectively.

The next will have angles at K and L, *three-fourths* of AB and BC from BC and AB respectively, and *one-third* further than D from AB and BC respectively.

The next will have angles at M and *b*, *four-fifths* of AB and BC from BC and AB respectively, and *one-fourth* further than D from BA and BC respectively.

And so we may pass on from angle to angle, getting successive angles E, G, K, M, &c., $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, &c., &c., of AB from BC, and $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c., &c., further than D from BA; and successive angles F, H, L, *b*, &c., $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, &c., &c., of BC from AB, and $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c., &c., further than D from BC.

The next longest either way will have angles at G and H, further than D from BA and BC respectively.

The next will have angles at K and L, $\frac{3}{4}$ of BC and AB from BA and BC respectively; and $\frac{1}{3}$ further than D from BA and BC respectively.

The next will have angles at M and *b*, $\frac{4}{5}$ of BC and AB from BA and BC respectively, and $\frac{1}{4}$ further than D from BA and BC respectively.

And so we may pass on from angle to angle, getting successive angles $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, &c., of BC and AB from BA BC, and $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, further than D from BA and BC respectively.

By a well-known property of the hyperbola these angles all fall on a hyperbola FDE through D, having BA and BC as asymptotes. The points thus obtained fall nearer and nearer together as the point D is approached.

In the figure the parallelogram BD is rectangular; but it need not be. The construction and comments remain unchanged if BD is rhomboidal.

III. *To inclose ten spaces by six ropes fastened to nine pegs.*

Draw two lines, BA, BC, as in fig. 4, preferably at right angles.

Divide AB into four parts, preferably equal at D, E, F, and

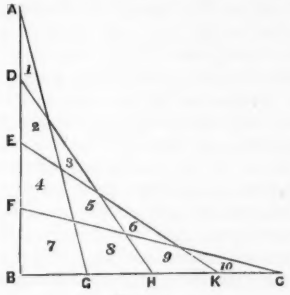

FIG. 4.

BC into four at G, H, K. Put the nine pegs at the nine points thus determined, and stretch the six ropes:—

(1) From A to B;
(2) From B to C;
(3) From A to G;
(4) From D to H;
(5) From E to K; and
(6) From F to C.

In the same way, with four ropes and five pegs, three spaces may be inclosed; with five ropes and seven pegs, six spaces; [with six ropes and 9 pegs, ten spaces]; with seven ropes and eleven pegs, fifteen spaces, &c., &c., and generally—

With $(n+2)$ ropes and $(2n+1)$ pegs $\frac{n}{2}(n+1)$ spaces may be inclosed.

If the figure is drawn symmetrically—that is, BA made equal to BC—and both BA and BC divided into the same number of equal parts, the lines drawn as AG, DH, EK, &c., all touch a parabola whose axis is the bisector of the angle ABC.

If BA and BC are not equal, but divided equally, the lines drawn as AG, DH, EK, &c., all touch a parabola, whose axis is parallel to a line drawn from B to the bisection of AC.

The last two puzzles suggest excellent methods for drawing hyperbolas and parabolas, on which we may hereafter touch.

Here is a puzzle worth working at a little, the solution being instructive as regards the linear and areal proportions of similar figures.

IV. *A farmer's property is in the form of a large ellipse, the farmhouse occupying a space which may be neglected by comparison with the farm, lying outside, but touching the periphery. At his death the farm is to be divided equally between the farmer's three sons, and so that each son shall have access to the farmhouse, but his estate shall be inclosed within a fence having the same length as the circumference of the undivided farm.*

The following puzzles depend on the properties of the stereographic projection:

V. *Draw six circles intersecting each other in eight points at angles of sixty degrees.*

VI. *Draw twelve circles intersecting each other in twenty points at angles of sixty degrees.*

THE NATURALIST'S LABORATORY.

CONTRIBUTION III.

THE *raison d'être* of a fireplace in the laboratory is obviously to warm the room during the colder periods of the year, but, like the window, it may be made to subserve other duties, and more notably to assist in the thorough ventilation of the apartment. The fireplace cannot, however, be constructed to provide for perfect inlets of fresh air with *economy*, and must therefore fulfil that function only as an adjunct to the ventilating window in small rooms, and to additional special inlets, such as those already described, for large apartments, viz., Boyle's mica flap ventilator, the Sherringham ventilator, and Lamb's air-box. Otherwise an adequate balance cannot be maintained between the fresh air introduced and the vitiated air which is expelled, and it is only by an observance of this grand principle that efficient ventilation can be secured.

A good fireplace for the laboratory, whether constructed to burn solid, liquid, or gaseous fuel, ought to combine many essential qualities. It should warm the room to the normal summer temperature quickly, and be capable of maintaining that degree of warmth without much deviation either one way or the other with a minimum of attention; it should provide for the complete removal of the products of combustion of the fuel in question; it should afford means for an inlet of fresh warmed air to assist in the thorough ventilation of the apartment; but, with all this, it should be economical. It is only within the past few years that this combination of requirements has been attained, and with success proportionate in each variety to the different available forms of fuel. Thus, when wood, peat, coal, and coke are burned in an open grate, a cheap and cheerful * fire is the result, and fireplaces made of stoneware, upon slow combustion principle, with shallow fireclay fuel-holders,

* "Cheerful" is a quality which is wholly dependent upon custom. No one would think of producing a similar optical effect in summer, nor after the transient twilight in the tropics, even though such could be produced without raising the temperature, *e.g.*, by the incandescent electric light specially modified.

fluted hearths, and a special arrangement for the entry of fresh warmed air, as in "Doulton's Syphon-action Ventilating Tile Grate," radiate a maximum of pure heat into the room, from an artistic and pleasing structure, with the only drawback attendant upon the nature of the material consumed, viz., the necessity for frequent removal of ashes, and the consequent dissemination of particles of dirt,* as well as of a tendency to an escape into the room of occasional impurities in the form of finely divided carbon (smoke and soot), carburetted and sulphuretted hydrogen, carbonic acid gas, and water vapour; but these drawbacks are comparatively trivial when expense is taken into consideration. Not, however, when a substitute in the form of a good *stove* is provided, as such an appliance affords all the desirable qualities of the open grate, save the cheerful aspect of the ruddy blaze; but then it has its drawbacks too, in the accumulation of ash, dust and cinders, which, however, can be minimised by the introduction of a suitable collecting receptacle. Such are the qualities embodied in Doulton's really beautiful warming-stove.

Mineral oils may be employed as fuel in place of solid combustibles, but, as somebody has said somewhere, "they are neither fish, flesh, fowl, nor yet good red-herring." They do not warm the apartment equably throughout, and are hence usually made portable, so as to be shifted about, especially if the room happens to be moderately large. It is true that they are cleanly, but that quality alone *versus* inefficient heating, cost of maintenance, the trouble of constant shifting and its inseparable concomitant the impoverishment of the atmosphere through combustion, deservedly dwindles into insignificance. A feeble attempt to imitate the "cheerful blaze" of a coal fire is sometimes made in the shape of an ingeniously-arranged metallic reflector and panes of ruby-coloured glass. They are useful, however, for very small laboratories, such as many a private student of nature can prevail upon the tender-hearted housewife to abandon to him, and the best pattern in the market is, without doubt, that of the "Albion Lamp Manufacturing Company," Messrs. Rippingille & Company, of Birmingham.

Lastly, coal gas may be used as fuel, and here, apart from costliness, is to be found the student's *desideratum*. A gas fire can be arranged to provide a cheery flame; all the products of combustion are most easily removed, fresh warmed air can be as readily admitted, and lateral chambers can be added wherein to do the "cookery of science;" there is no dirt to be removed, with practically no attention to be bestowed upon the maintenance, nay, the accurate regulation, of the warmth in the laboratory; but, alas! all of these advantages are only too often overbalanced by the state of the poor naturalist's exchequer. The name of Fletcher is inseparable from this subject on account of the many forms of heating apparatus which he has invented, and which so justly entitled him to the celebrity he enjoys.

The artificial lighting of the laboratory is not to be commended for careful work, elaborate dissections, observing with the microscope, or in delineating objects. One hour's devotion during the daylight with the clear light reflected from cumular clouds or a bright blue sky is, according to the experience of the majority of persons, positively delightful in contradistinction to the feeling akin to pain engendered by even a few minutes of study with the aid of unnaccustomed, and, *ergo*, unnatural light. Still, there are many cases in which a steady clear lamp or gas flame is able to afford results which cannot so well be attained by daylight; for instance, as in researches respecting the true nature of natural diffraction gratings, *e.g.*, the tests of diatomaceous plants, *Pleurosigma angulatum*, *Amphipleura pellucida*; &c., in continuous investigations into the optical qualities of amplification and resolution in relation to the angular aperture of lenses, the study of the life-history of such minute creatures as *Monads*, &c., all of which make it necessary for the student to employ an unfailing, predirected, and uninterrupted source of light. But these operations are immediately without the limits of this paper, and are only rarely followed by special enthusiasts—Mr. Nelson, Professor Dallinger, Dr. Abbe, and others, whose untiring energy can alone supply them with the necessary "ins and outs" to enable them to prosecute their inquiries with success.

Still, artificial lighting must not be wholly neglected, as it may often be used with great advantage. For occasional work, for displays, and for literary labour, the "midnight oil" will always be welcomed, and, from the nature of the manipulator's occupations, a steady, clear, *portable* light must obviously be the best, so that the employment of mineral oils which have long since superseded animal and vegetable oils, both as regards economy and efficiency, must be preferred to gases as illuminants. The reason for this choice is that, although coal gas has during the past decade been so improved upon that "the amount of sulphur around a gas-burner is, at least in London, less than half what it was a few years ago, there is still, however, a step in advance to be taken, eight or ten grains of sulphur in every 100 cubic feet of gas still to be removed, before gas can claim to be in this respect as perfect a domestic illuminant as candles or oil."* As regards mineral oils, where such are used as heat-givers in addition to their illuminative function, Mr. George J. Snelus says†:—"One difficulty connected with their use for this purpose is that imperfect combustion gives rise to very unpleasant odours; but where combustion is perfect, as in a good Hinks, Silber, or Mitrailleuse lamp, considerable heat as well as light may be obtained at a very small expense, and in a very convenient way. The products of combustion, however, should, if possible, be carried off by special arrangement when large burners are used, although, from their freedom from sulphur, they are not nearly so deleterious as those of gas."

A few observations upon the construction and uses of mineral oil lamps may therefore be noted in this place for the benefit of the student. Captain Shaw's report for 1884 shows that, of the known causes of fires in London, one-fifth can be traced to the overturning or explosion of mineral lamps, as the nature of the volatile liquid is antagonistic to its being heated or exposed to the open air in the presence of flame. Although the flame of a mineral oil lamp cannot be super-heated and its illuminating power increased by being fed with heated air, as in many forms of the gas flame, its careful construction is capable of being so highly utilised that in one lamp called the "Defries' Safety Lamp" (Sepulchre's patent), an average illuminating power of 52·14 standard candles‡ has been registered by a series of careful photometric tests. The lamp is constructed with but a single wick, and, when its candle-power is taken into consideration, it burns less oil than any other lamp yet introduced. Mr. Boverton Redwood's report upon the lamp gives a good idea of the essential requirements of a thoroughly efficient appliance. He says:—"The construction of this lamp is such that neither ignition

* The term "dirt" here must be understood to signify "matter in the wrong place."

* Dr. A. Vernon-Harcourt, Official Catalogue of the International Inventions Exhibition, London, 1885, p. 171.

† "Fuel, Furnaces, etc.," Official Catalogue of the International Inventions Exhibition, London, 1885, p. 184.

‡ "A sperm candle of six to the pound, burning one hundred and twenty grains an hour." Cf. the Metropolis Gas Act, 1860.

of the vapour nor overflow of the oil in the event of the lamp being overturned can occur. Moreover, the oil reservoir, being of metal, is not liable to fracture. . . . The light emitted is remarkably white, the flame is perfectly steady, and the combustion is effected without the slightest odour or smoke." It may be added that the reservoir of ordinary mineral oil lamps ought not to be filled to the brim, the wick should not quite reach to the bottom of the reservoir, the flame on being first lighted should be turned down low and then gradually raised, and, in extinguishing, the wick ought to be lowered and a puff of air sent immediately past the top of the chimney, and not directly down its shaft. If these precautions are taken, the risk from explosions would be practically abolished.

It has been estimated that an ordinary jet of gas, which consumes five cubic feet per hour, deprives the air during that period of all the oxygen from fifty cubic feet of space, and produces five cubic feet of water vapour, besides a small proportion of smoke carburetted and sulphuretted hydrogen; but these deleterious products of combustion can be readily removed through the agency of a special tube placed over the gas flame and leading thence to the external atmosphere; but, of course, such provision has not yet been made for the *portable* laboratory lamp.

Gossip.

By Richard A. Proctor.

I have long felt dissatisfied with what may be called the literature of astronomy, in which we find nothing comparable with the admirable geological works by Lyell, the Geikies (especially Alexander), and others. We have works by the surveying astronomers, who preside at national observatories, and who, though admirably skilful in time measurement and in all the processes of mathematical calculation on which the application of astronomy to commerce (the real object of national observatories) depends, have little insight into the philosophy of astronomy, and, indeed, care little for the science in its nobler aspects. Then we have works written (generally to order) by those who may be called rather the vulgarisers than the popularisers of astronomy.

* * *

On the one hand, specialists, with marvellously exact knowledge of some small department of the science, give us their views—as little satisfactory as would be a description of some great cathedral made by a workman who had passed all his time close by some particular pillar. (The pillar may be very necessary, and, perhaps constitute an important feature of the structure, yet it must obstruct, for one who has stood too closely by it, all view of the proportions of the edifice.) On the other hand, we have writings by men who imagine that a sufficient general view of this noble science can be obtained by a few months' study of other people's work.

* * *

It has long appeared to me that something remained to be done for the literature of astronomy, which, so far as I know, no one has yet attempted, viz.: that one who loved the science should devote many years of time to study its general scope, while yet obtaining such sufficient knowledge of its various parts—observational, mathematical, physical, theoretical, and practical—as to be able to picture these correctly, though in due subordination to the general plan. It may be said that this has been done in Herschel's "Outlines of Astronomy." Sir John Herschel's book comes nearest, indeed, to my idea of what a book on general astronomy should be in order that it may duly instruct and move men's minds—for this, outside its commercial application, I take to be the great purpose and to constitute the chief value of the science of astronomy. But, greatly as I revere the memory of both the Herschels, father and son, I cannot but recognise in John Herschel's "Outlines" a want of symmetry which mars its worth as a work for instructing the world. There are sections, nay, whole chapters, which seem quite out of place in such a work. The last third of the book is, however, very fine.

* * *

Unfortunately Herschel's book is now falling out of date. Astronomy is advancing all the time. It does not require great astronomical discoveries to carry it forward—though, of course, they do so. The advance constantly taking place in our knowledge of physical laws enables us to view astronomical problems with constantly increasing clearness of perception.

* * *

Then astronomy, like other sciences, has gained greatly—perhaps it has gained more than all other sciences—from the growth of men's ideas as to the range of law alike in time and space. Greatly as the astronomy of Newton differed from that of Ptolemy (nay, even from that of Copernicus and Kepler), it did not differ so much from the earlier astronomy as the astronomy of our own time, recognising laws of evolution and development operating throughout all space and throughout all time, differs from the astronomy of Newton's time. *Then* the recognition of law in God's universe seemed like setting God on one side in the name of law; *now* we find in the doctrine of universal law, operating through periods of time to us practically eternal, and extending throughout what for us is infinity of space, simply the recognition of perfect congruity between the laws of God and the domain alike in space and in time for which those laws were made. We find in ideas once held to be essential to men's right estimate of Deity a want of all proper recognition of what the Power "working in and through all things" and throughout all time must necessarily be. To us the old ideas, for rejecting which we are thought by the weak-minded to be wanting in reverence, would be simply blasphemous; though we admit and feel that respectable persons who still entertain them are not really wanting in respect for that infinite, though (otherwise) unknowable Power.

* * *

If it be asked how we can speak of a power as infinite in the same breath in which we speak of it as unknowable, I reply, "As reasonably as we can speak of yonder star as a sun, far vaster and far mightier than this earth on which we live, in the same breath in which we say that the size and might of that star are unknown and (in all probability) unknowable."

* * *

The doctrine of evolution, which had its origin in the science of astronomy, is held by the shortsighted folk, who look at all science from without, as something dangerous for the world. I should be very sorry to think any doctrine which I know to be sound, and believe to be on its way to admission as universal as that accorded to the astronomy of Newton, can be dangerous for the world. It must be a very weak, or else a very ill-constructed world, if that is the case. If there is any danger, it must be because of the mischievous work of those ignorant fanatics who, in their zeal or their own vain notions, have not been unwilling to

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tie their religion, and the religion of those unwise enough to trust in them, to rotten and ill-rooted stumps. If, as false ideas give way, true thoughts are for a time swept away with them, the fault is not with those who displace the false ideas, but with those who have too long persisted in teaching men to put their trust in those mistaken notions.

* * *

So far from admitting that there is danger in modern astronomy, I consider that the science has emphatically religious and moral value. Apart from all other considerations, astronomy, as the science which above all others teaches the prevalence and universality of law, must teach also most strongly what I take to be the most valuable of all lessons for men, "the futility of lawlessness, no matter under what high or seemingly sacred name disguised."

* * *

THOUGH I am a believer to the fullest extent in free trade, regarding protection as a device only fit for nations which have barely emerged from barbarism, I regard the idea underlying fair trade as a sound one. Or, rather, I so think because I am a free trader.

* * *

FAIR trade would be a sure way, in certain cases at any rate, of destroying protection. For example, if England put a five per cent. duty on American grain, the grain States of the West would not long put up with the injustice of a protective system, under which they are already groaning. Free traders who think more of the name than of the thing may be content to wait till Indian grain has killed the American grain trade with Great Britain, and doubtless the injury to America so brought about will be more deadly that way—will, in fact, be irreparable—whereas a retaliatory duty would be but temporary, and need even be little more than a threat. But irreparable mischief to one country means always mischief to other countries too. England, for example, suffers indirectly almost as much as America from the destructive protective system adopted by short-sighted American "politicians."

* * *

AMERICANS are confident that England is too thoroughly committed to free trade to attempt retaliation. But if England recalled how she got free trade she would see the probable efficiency of fair trade measures. For England was herself driven from a protective system scarcely less absurd than the American by the fair trade threats of other countries, among which, by the way, America was the loudest.

* * *

CONSIDERING the sad case of the royal family of Bavaria, we in England may ask (with some right to put the question) whether the royal family of England has escaped the manifold afflictions, bodily, moral, and mental, resulting from the intermarriage of cousins. The English royal family has a tolerably wide range of German cousins, or cousins german, to choose from—though, being itself of full German blood, this indicates small room for escape from the evil effects of inter-breeding. Its German record has not been satisfactory. George I. was a pig-headed bully, and George II. only differed in being rather more so. George III. was never really sane, and often very insane. George IV. was as mean a profligate as the annals of even royal scamps record. Of William IV. the Greville Memoirs show us enough to leave little doubt in any reasonable mind that he was something between George III. and George IV., or, as Sheridan said (when George asked him whether he—Sheridan—was more knave than fool, Sherry walking at the time between George and a companion of no very brilliant mind), he was something between knave and fool. Of course, while William lived, none of those who really knew his nature would venture to say what they thought of him.

* * *

IT is amusing, by the way, to find from the later Greville Memoirs that Albert (the Good) used to get angry when anything was said about the royal family. He wanted to institute a sort of inquisition for the punishment of those who thus offended. Very likely there was enough to anger him. Yet the English people pay a high enough price for the discharge of certain easy duties by their kings and queens; and every Englishman has therefore the right to express an opinion as to the likelihood that these duties will be respectably discharged.

* * *

THE disclosures about the social riots in Chicago reveal depths of brutality such as only the dynamite outrages had before suggested. Many receive with intense annoyance and disgust the doctrine that men are akin to the higher apes, and therefore to all orders of monkeys, and through them to lower races of animals. If you ask why they thus object to the alleged relationship, they speak of the great difference between man and all other animals, in that man possesses reason, can distinguish between right and wrong, has been made in fact but "a little lower than the angels." Kinship with beasts not next door to angels, having no sense of right and wrong, not indeed wicked, but absolutely and necessarily wanting in moral goodness, they regard as degrading.

* * *

IT may be so or it may not be. It may be degrading to be formed of the same materials, to breathe the same air, to feed on the same forms of food, as animals; or, on the other hand, we may be quite mistaken in calling these poor relations of ours common and unclean even when in the same breath we admit that they are our fellow-creatures. But if it is degrading to be akin to apes and monkeys, and through them to other animals, what depth of degradation ought we not, by parity of reasoning, to recognise in our unhappy but unquestionable kinship with creatures who, having reason, having (we may presume) the knowledge of good and evil, are deliberately and of set purpose not only evil but hideously wicked. If, being a little lower only than angels (alas, poor angeldom!), we scorn the thought of being akin to mere animals, how are we to bear the certainty that we are of the very same race as some who are not higher than devils?

* * *

I KNOW, indeed, as little about devils as I know about angels. I take the ways of both on trust. Dante and Milton have given us their ideas about devils, and here and there scattered throughout literature, ancient and middle-aged (but especially the latter), we find ideas thrown out about the manners and customs of the wrong sort of angels. I venture, however, to assert with considerable confidence that if any writer, of prose or poetry, had gone so far as to attribute to the blackest of Satan's crew such unutterable wickedness as the dynamiters and bomb-throwers have displayed in deliberately planning the haphazard slaughter and mutilation of men, women, and children, who had done them and wished them no evil, then that writer would have been justly charged with using tints too hatefully black even for devils.

* * *

HATRED and malice, greed and lust, these as motives to murder, and murders through such motives as these, we can

understand. The world has been familiar with *such* atrocities from time immemorial. But haphazard murder, or attempts to murder, with no other motive but the idiotic notion that by injuring the innocent those hated as imagined wrong-doers may be terrified—this is what, until the last few years, the world had not seen; nor had even the liveliest imagination conceived such horrors.

* * *

AMERICANS, however, are rather amused, if not over well pleased, at the way in which the iniquities of recently-arrived ruffians—aliens and foreigners—are quietly attributed in Europe to American democracy. In America they are attributed, perhaps as absurdly (but perhaps not), to the degrading influences of the monarchical system. To attribute them to American institutions is as preposterous as it would be to attribute political or municipal wrong-doings in America to democracy. This last mistake, by the way, incredible though it may seem, has been made by certain of the more old-fashioned folk in the old country.

Reviews.

Microbes, Ferments, and Moulds. By E. L. TROUESSART. International Scientific Series. (London: Kegan Paul, Trench & Co. 1886.)—The subject of M. Trouessart's volume possesses a peculiar interest at a time when we are assured that the researches of Pasteur have resulted in the discovery of a prophylactic against that most dread disease hydrophobia; and when, consequently, the words "microbe," "bacteria," &c., are often heard from the lips of those whose ideas of what they are talking about are of the very vaguest. The task set himself by our author is to give the previously uninstructed reader clear and definite information as to the nature and functions of those microscopic cryptogamous plants which are believed by a large and increasing number of pathologists to be, if not the primary causes, at all events the invariable concomitants of specific forms of disease. This he does with all that clearness and charm of style which distinguish popular French scientific literature, and which suffer nothing in the very excellent rendering of his anonymous translator. Following an introduction, in which the nature and general characteristics of microbes and protista are set forth, come nine chapters:—The first, on Parasitic Fungi and Moulds; the second, on Ferments and Artificial Fermentations; the third, on Microbes, strictly so-called, or Bacteria; the fourth, on the Microbes of the Diseases of Domestic Animals; the fifth, on the Microbes of Human Diseases; the sixth, on Protection against Microbes; the seventh, on Laboratory Research and Culture of Microbes; the eighth, on the Polymorphism of Microbes; while the ninth summarises the arguments of those which precede it, and compares the microbian theory with others advanced to explain the origin of contagious diseases. Eight appendices further elucidate points in the text of the first five chapters. If we felt disposed to cavil at M. Trouessart's treatment of his subject, we might be tempted to refer to the manner in which he speaks of things as irrefragably established which, to put it in the most favourable way, are, at least, at present only *subjudice*. To take a single example: he talks (on p. 197 *et seq.*) of the "comma bacillus" as the undoubted proximate cause of cholera, an assertion on the truth of which the very gravest doubt has been thrown by the results of recent investigation and discussion. And so in other cases, he appears to us to make allegations which, if not unwarrantable, are at all events unwarranted in the existing imperfect state of our knowledge. It is notable, too, that practically the only Englishman who gets any credit for the results of his investigations in microbial pathology is Sir Joseph Lister, to whose antiseptic system of surgery, however, he does full justice. But this does not prevent his book being at once readable and valuable to those desirous of obtaining a competent general knowledge of its subject, and it may be safely recommended to all who wish to do so.

Echetlus: Considerations upon Culture in England, by GEORGE WHETENALL (T. Fisher Unwin), is, without doubt, a most original book, written by a man so far out of joint with the age he lives in that he finds something to condemn in everything in which it triumphs most proudly, from the telegraph, telephone, and railway to the sewing-machine and the School Board, which he, with justice, stigmatises as "a machine for thrusting poor baby-wits of every shape and size through a regulation sieve." He rightly indicates the evils of the examination fever now so rife, and suggests that parents like to see the certificate or diploma as a sort of guarantee that their money has been properly expended on education by "a system which fills the fresh minds of children with surfeit and flatulence of disorderly fact." Though few would be willing to follow Mr. Whetenall, in that the majority would consider his wish to return to a simpler, more arcadian life—abolishing the outcome of recent years in the way of machinery, gas, steam locomotion, cheap literature, &c.—unpractical, his book is by no means despicable, inasmuch as it serves to point out many evils overlooked in the general complacency of the age, and the truth of many of his contentions is beyond question. At a time when the milk-and-water style of composition prevails so extensively as at present the force and vigour of Mr. Whetenall's writing and the eccentricity of his language, which returns to a purer epoch of English literature, render his book welcome to the jaded critic.

Mechanics and Faith: a Study of Spiritual Truth in Nature. By CHARLES TALBOT PORTER. (New York and London: G. P. Putnam's Sons. 1886.)—It has been jocularly said that the first Mr. Smith has a tremendous deal to answer for. Upon a cognate principle, we cannot but feel that Professor Drummond incurred a considerable amount of responsibility by publishing his "Natural Law in the Spiritual World;" giving rise, as that work has done, to such numerous imitations, of a more or less weak and wishy-washy character. Beyond the exhibition of an earnest and reverent spirit, we are sorry to say that we can find nothing to praise in this latest attempt at reconciliation. Mr. Porter's style is as dreary and monotonous as his tone is dogmatic, which is saying much. If from the weary mass of iteration and reiteration of which the book consists we endeavour to make a *précis* of his argument, the difficulty is found to be great indeed. Perhaps it may convey some idea of its character, however, if we say that the human mind is (according to Porter) incapable *per se* of apprehending or discovering any physical truth; that mechanical inventors have only proceeded tentatively, and succeeded after failures more or less numerous; and that hence all so-called mechanical discoveries are really revelations! He further denies the existence of reason as a special intellectual faculty, and at the same time claims blind obedience to the teaching of the Bible. How without the prior exercise of reason anyone is to satisfy himself that the Bible must demand such obedience, he fails to inform us. If by carefully weighing the best available evidence a man convinces himself that the Bible is actually the Word of God, then at his peril he neglects to listen to it. If, however, he accepts it simply on account of certain assertions contained in it, without the employment of his

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reasoning faculties at all, then upon the same principle he would not be justified in rejecting the Koran, or even the Book of Mormon, as revealed to the Prophet Joe Smith. Our author, from the supreme height of his own infallibility, naturally looks down upon such poor creatures as Tyndall and our other great physicists and men of science, and regards the atomic theory, or the notion of material atoms at all, as a mere figment of the imagination. The entire volume consists of sermonising of a very dreary character, and has been seemingly written under the venerable delusion that a statement is proved if it merely be only repeated often enough.

Solar Heat, Gravitation, and Sun-Spots. By J. H. KEDZIE. (Chicago: S. C. Griggs and Co. 1886.)—Mr. Kedzie's ideas may be summarised by saying that he regards the ether which fills all space, and whose undulations become known to us in the form of light, heat, and electricity, as the transmitter of waves from every sun in the universe; such undulations, if we understand him rightly, successively degrading through electricity, light, and heat until, when they become slow enough from the enormous distance through which they have travelled, they become manifest only as mechanical force. When, however, these waves of energy break upon a sun, they are at once converted into heat, and hence, according to our author, the perennial supply of heat to the centre and fountain of our own system. But, further, as these waves of energy are travelling radially—if we may so speak—from the confines of space, some of them must be intercepted by bodies on which they impinge, and any two given bodies (say the sun and the earth) must shield each other, to a certain extent, from the impact of these waves, and so be pushed together. Here is the explanation of the force of gravitation in a nutshell! Why, though, on this hypothesis, *mass* should determine the amount of gravitative power our author does not inform us. It would rather seem that volume, or sectional area, should regulate the force with which two bodies should approach, as the larger the section of any sphere the more undulations it must intercept. Sun-spots, &c., are explained by the shielding of parts of the sun's disc by the planets, and so on. It must not, however, be imagined from this brief *résumé* of Mr. Kedzie's book that he is a mere vulgar paradoxer. Heterodox he may be, but it is abundantly evident that he has devoted an immense amount of thought to the hypothesis which he sustains with unusual force and ability. At all events, his book is worth reading.

The Theory and Practice of the Slide-Rule, with a Short Explanation of the Properties of Logarithms. By Lieut.-Colonel JOHN R. CAMPBELL, F.G.S. (London: E. & F. N. Spon. 1886.)—Assuming the beginner to possess a certain familiarity with elementary algebra, he will find Colonel Campbell an efficient and trustworthy guide to the use of that very handy instrument for approximate calculations, the slide-rule. The author begins by explaining the nature and properties of logarithms, and then goes on to show how the logarithmic scales are divided and used on the ordinary carpenter's rule. In a short chapter Colonel Campbell subsequently describes the construction of the less familiar "circular slide-rule," and concludes his work with an explanation and illustration of a method of making a magic-lantern slide to exhibit the principle and working of the instrument to a large lecture audience. This is a useful little book.

Wit and Wisdom of the Rev. Sydney Smith. Wit and Wisdom of Benjamin Disraeli, Earl of Beaconsfield. (London: Longmans, Green, & Co. 1886.)—Recording the utterances of two men, intellectually wide as the poles asunder, the volumes whose titles head this notice may be regarded as a Thesaurus for the essayist and the public speaker, as well as excellent companions on a railway journey, among the mountains, or by the seaside; since they may be taken up and opened anywhere with the certainty of finding amusement and instruction. Their trivial cost might be mentioned as an additional reason for buying them, but that no such reason is in reality needed.

Plain Talk for Plain People. By JOHN VAUGHAN. (London: Joseph Toulson. 1886.)—This volume is made up of thirteen sermons apparently preached in the Primitive Methodist Chapel of which their author is pastor. If Mr. Spurgeon or "General" Booth affected written discourses they might purchase (and preach) Mr. Vaughan's with advantage.

Der Bibliothekar. By GUSTAV VON MOSER. Edited, with literary introduction and notes, by FRANZ LANGE, Ph.D. (London: Whittaker & Co. and George Bell & Sons. 1886.)—This is the German original of "The Private Secretary," over which so many of those who will read these lines have laughed at the Globe Theatre. The introduction and notes add to its value for the English student of German.

The Kennel Review (London: 95 Strand) addresses all who love and are in communication with dogs, either on terms of intimacy or of merely general acquaintance.

Our Chess Column.

BY "MEPHISTO."

THE following games were played in the recent Tournament of the British Chess Association:—

GIUOCO PIANO.

	White. I. Gunsberg.	Black. Zukertort.		White. I. Gunsberg.	Black. Zukertort.
1.	P to K4	P to K4	17.	Kt to R7	R to K sq
2.	Kt to KB3	Kt to QB3	18.	P to QB4 (*h*)	Kt to Kt5
3.	B to B4	B to B4	19.	Kt to B6 (ch)	K to R sq
4.	P to Q3	Kt to B3	20.	Kt × R	Q × Kt
5.	B to K3	B to Kt3	21.	P to QR3	Kt to B3
6.	Kt to B3 (*a*)	P to Q3	22.	P to B4	Kt to B4
7.	Q to Q2	Kt to K2 (*b*)	23.	B to B2	B to K3
8.	Castles QR	P to B3 (*c*)	24.	R to Q6 (*i*)	P to QKt3 (*j*)
9.	P to Q4 (*d*)	B to R4	25.	P to B5 (*k*)	B × QBP
10.	Kt to KKt5 (*e*)		26.	Q to B4 (*l*)	

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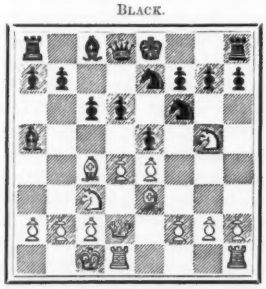

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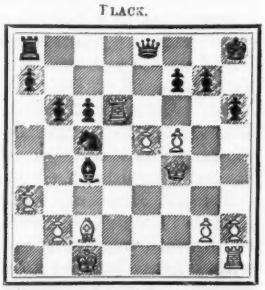

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10.		P to Q4	26.		B to Kt6
11.	P × KP (*f*)	Kt to Kt5	27.	R × P (ch) (*m*)	K to Kt sq
12.	P × P	Kt × B	28.	R to R3	B × B
13.	Q × Kt	B × Kt	29.	Q to R4	K to B sq (*n*)
14.	Q × B	Kt × P	30.	P to B6	P × P
15.	Q to KKt3	Castles	31.	P × P	Kt to Q6 (ch)
16.	B to Q3 (*g*)	P to KR3	32.	R × Kt	Resigns

NOTES.

(*a*) This move is preferable to 6 P to B 3. If necessary, the Kt, as usual in this opening, may be transferred to the King side viâ K2 and Kt3. The advantage of this manœuvre, however, has not been reliably demonstrated by practical play.

(*b*) Black might have gained a move by opposing his B on K3.

(*c*) A move of serious consequences for Black. All routine moves do not always hold good, especially when one player varies an opening by adopting a more active line of play. The usual object of playing P to QB3 in this opening by Black is to take advantage of White's early castling on the Q side by playing B to B2, and, after castling KR, to advance the Pawns both in the centre as well as on the Queen's side.

(*d*) This move secures White a considerable advantage; Black has no good reply. If he plays B to B2 White wins a P by 10. P × P, P × P. 11. Q × Q(ch) &c. If Kt to Kt3 Black should likewise maintain an advantage by proper play, *i.e.*:—

9.		Kt to Kt3		
10. P × P		P × P	or	10. Kt × P
11. Q × Q(ch)		B × Q		11. B × B Q × B
12. Kt to Kt5		R to Bsq		12. Kt × Kt P × Kt
13. Kt × BP and wins				13. Q to Q6 with advantage.

(*e*) Very effective both for defensive and offensive purposes. Black cannot castle now as the following play will show. If 10 . . . Castles, 11. P × P, P × P. 12. Q × Q, B × Q. 13. Kt × BP and wins. Black is compelled to play P to Q4 to protect his KBP.

(*f*) Best, for if Black now replies with P × B, then 12. Q × Q, B × Q. 13. R × B (ch), K × R. 14. Kt × P (ch) and wins.

(*g*) A double-barrelled menace. If Black protects his KRP by P to KKt3, White plays 17. P to QB4, threatening B × KtP, if the Kt moves away.

(*h*) This is better than the possibility of winning the Q by 18. Kt to B6 (ch), Kt × Kt. 19. B to R7 (ch), K × B. 20. R × Q, R × R, Black having three pieces.

(*i*) The R here occupies a commanding position, but the particular object of the move will be apparent in the next few moves.

(*j*) Black could not play B × P at once on account of Q to QB3. This move also gives Black a square for his Kt or Kt2.

(*k*) It is very curious to note the sequence of the moves throughout the whole game, Black hardly having any choice but to submit to White's ideas. P to B5 does not leave Black time to play Kt to Kt 2.

(*l*) White gained an important move by having allowed Black to take the QBP, as this enabled him to attack Black's B and the RP simultaneously, the latter being White's real point of attack from the moment he played R to Q6.

(*m*) Black cannot take the R, for then follows 28. Q × P (ch), K to Kt sq. 29. P to B6, and mates in two.

(*n*) P to B3 would have delayed the finish a little longer.

HAMPE ALLGAYER.

White. I. Gunsberg.	Black. G. H. Mackenzie.	White. I. Gunsberg.	Black. G. H. Mackenzie.
1. P to K4	P to K4	16. Kt × Kt	B × P (ch)
2. Kt to QB3	Kt to QB3	17. K to K2	B × P (*g*)
3. P to KB4	P × P	18. Kt to B3	B to Kt3 (*h*)
4. Kt to KB3	P to K Kt4	19. QR to KB sq (*i*)	B to K2 (*j*)
5. P to KR4	P to Kt5	20. K to Q sq	P to Kt6 (*k*)
6. Kt to K Kt5	P to KR3	21. Kt to Q5 (*l*)	Q to Q2
7. Kt × KBP	K × Kt	22. Kt to B4	Q to Kt5 (ch) (*m*)
8. P to Q4	P to B6 (*a*)	23. K to B sq	B × P
9. P × P	B to K2	24. KR to Kt sq	B to B3 (*n*)
10. B to K3 (*b*)	P to Q3 (*c*)		
11. B to B4 (ch)	K to Kt2		
12. P to B4	Kt to B3		
13. P to B5 (*d*)	P to KR4		
14. Q to Q2 (*e*)	P to Q4 (*f*)		

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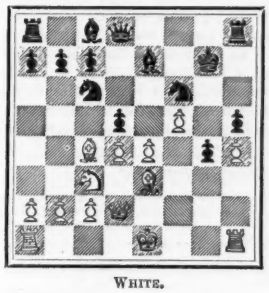

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15. B × P	Kt × B

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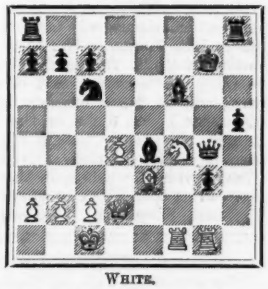

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25. P to Q5 (*o*)	Kt to K4
26. K to K6 (ch)	K to B2
27. Q to B3 (*p*)	K to K Kt3
28. B to Q4 (*q*)	Kt to B6
29. B × B	P to Kt7 (*r*)
30. R × P	Resigns.

NOTES.

(*a*) This interesting opening is not often ventured upon by one strong player against another in tournaments. Several moves are available for the defence. Of these moves P to Q4 seems the best.

(*b*) Zukertort suggests 10. B to B4 (ch), K to Kt2. 11. Castles.

(*c*) B × P (ch) deserves preference.

(*d*) This move weakens White's centre. 13. P to Q5 was much stronger. White would gain important time, as the Kt has no good move. If Kt to R4, 14. B to Q3; or if Kt to Ktsq, 14. Q to Q2, followed by 15. Castles QR with a good game.

(*e*) The danger for White is obviously that Black would attack his centre position by P to Q4. The best move now would therefore have been Castles, as thereby the KBP would have been effectually defended.

(*f*) A very judicious advance if now 15. P × P, Kt to R4. 16. B to Q3, Kt × P with advantage.

(*g*) This move gives Black an undoubted superiority.

(*h*) A little more boldness would have secured Black's victory. He ought to have continued B × P. If then 19. Kt × B, R to Ksq, and Black ought to win, for if White defends the Kt by 20. Q to Q3, Kt to Kt5, or if 20. Kt to B2, Kt × P (ch), followed by Kt to B6, wins without much trouble or calculation.

(*i*) A move of great importance for White's future prospects.

(*j*) Necessary in order to free the Queen from her responsibility of guarding the B.

(*k*) By the last two moves White has gained important time to rally his forces for a second attack. P to Kt6 weakens Black's position considerably; his best was probably Q to Q2, and if White then played 21. P to Q5, Black should give up the Kt and play QR to KBsq to avoid the attack following on Kt to K4 by 22. B to Q4, &c. The two passed Pawns ought to win the game.

(*l*) The initiative move of a good attack. If B × P, 22. Kt to B4, threatening Kt to K6, also Kt × P (ch).

(*m*) The White K is safer on QB sq, whereas the Black Q is more precariously posted on Kt5 than on Q2.

(*n*) With every move White's prospects are improving. Black could not now defend his KKtP, for White threatened to win a piece by 25. P to Q5, Kt to K4. 26. Q to Q4, &c; to prevent which Black is compelled to play B to B3. Black never again gets the chance of playing P to R5. It must be noted that neither in reply to check with the white Q nor with the B can Black interpose his B on B3, as White would reply with Kt checks, and then take the B.

(*o*) In reply to this move, Kt to Q sq would result in 26. B to Q4, with a very awkward position, as Black could not defend the B with R to KB sq on account of 27. R × P, Q × R. 28. Kt × P (ch), winning the Q.

(*p*) Every move is full of deep complications. This seems best, although there are other promising moves. The attacked Kt cannot move, for White threatens 28. Q × P (ch), followed by 29. R × P.

(*q*) This move strongly increases the pressure of White's attack, to which Black has no defence if P to R5. 29. B × Kt, B × B. 30. Q × B, with a hopeless position for Black.

(*r*) This, of course, loses. Black might have prolonged the game by playing Kt × R. 30. R × Kt, P to R5. 31. B × R, K to R2. 32. B to B6, &c.

WHIST.

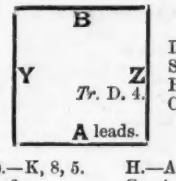
BY "FIVE OF CLUBS."

THE following game is taken from an old number of the *Westminster Papers*, to which it was contributed by Mr. F. H. Lewis, who held hand *B*. It shows how a skilful strategist plays to make a long suit effective when the enemy has equal strength in it. It also affords an admirable illustration of the proper use of false cards, where a partner, by careless play, has rendered such a resource necessary to win or save a game.

THE HANDS.

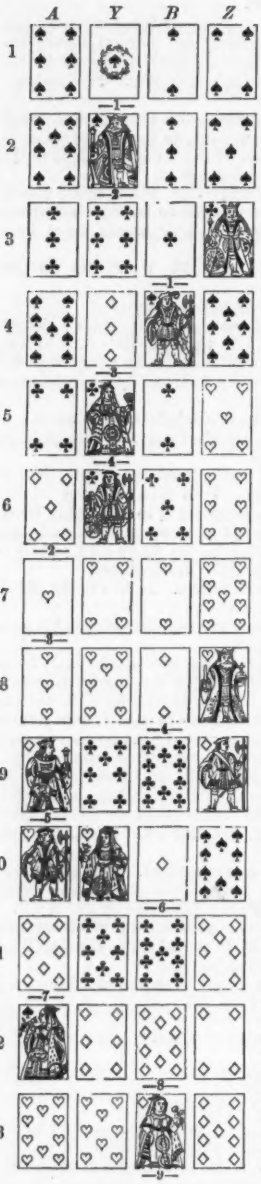
B: D (*trumps*)—A, Q, 10, 2. S.—Kn, 3, 2. H.—2. C.—A, 10, 9, 5, 2.

Y: D (*tps*).—6, 3. S.—A, K. H.—Q, 8, 7, 4. C.—Q, Kn, 8, 7, 6.



Z: D (*tps*).—4, 7, 9, Kn. S.—4, 5, 8, 10. H.—5, 6, 9, Kn. C.—K.

A: D (*trumps*).—K, 8, 5. S.—Q, 9, 7, 6. H.—A, Kn, 10, 3. C.—4, 3.



NOTES ON THE PLAY.

Card underlined wins trick; card underneath leading next.

1 and 2. The Heart Three was the best lead. *Y* would have done wisely to have played the Spade King, and followed with a small Club. He plays, of course, to invite a force from *Z*. But the force comes most effectively and disastrously for *Y–Z* from the enemy. By playing the King and waiting *Y* would not only have retained the commanding Spade, concealing his weakness, but would have played best for the chance of a cross ruff.

3 and 4. *B* seeing that *Y* leads his own long suit, makes the Ace at once, and by forcing *Y* draws him on to give up the command in Clubs Seven. *A* might well have led his Spade Queen, since the Ten probably lies with *Z*. If the Spade Ten had been with *B*, yet *Y* after taking the trick would have had to lead Clubs or Hearts, either of which would have been advantageous for *A–B*. Of course the Heart lead, as events turned out, gave the game to *A–B*, but that proves nothing. *A* had no means of knowing that *B* could ruff Hearts second round, killing the King.

9. As the cards lie, the lead of Diamonds Ten would give the game to *A–B*. But *B* plays best, according to the chances. He knows *Y* holds the two smaller Clubs, and that if *A*, lying over *Z*, can win the trick he will be led through in trumps, which, with the double major tenace, is, of course, what he wants.

10. Here *A* should have led the trump. By leading a Heart he forces *B* (so far as he himself knows) to part with his best trump without drawing any from the enemy. *Z* has no more Hearts, so that *B* is in no better position (as respects *Z*) to a Heart lead than to a trump lead. But a trump lead would have drawn two trumps from *Y–Z*. Even if *Z* had held four and *Y* none, nothing would have been lost by the lead, for one of *Z*'s four trumps would have made in any case. *B* is obliged to play a false card to win the game, which would have been won so simply had *A* led properly. By playing the Ace he hides the position of the Queen and Ten, either or both of which may be with *Y*, or the Ten may be with *A*.

11. But *Y* should have trumped with the Nine. The position is not one for finessing.

12 and 13. *A–B* make three by tricks, which, with two by honours, give them the game.

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THE FACE OF THE SKY FOR SEPTEMBER.

By F.R.A.S.

THE sun's disc may still be watched for spots and faculæ, although they are less both in number and frequency. The night sky is shown on map ix. of "The Stars in their Seasons." Minima of the variable star Algol ("The Stars in their Seasons," map xii.) will occur at 10h. 49m. P.M. on the 11th, and on the 14th at 7h. 38m. P.M., as also on other occasions when the phenomenon will not be conveniently observable. Mercury is a morning star all through the month, and may be caught with the naked eye twinkling over the eastern horizon before sunrise. He is at his greatest elongation west of the sun (18° 5′) on the morning of the 2nd. The student who sits up or gets up to watch for the planet may, towards the end of the month, see the Zodiacal light before sunrise, in the east. On the 6th Mercury will be only some 37′ north of Regulus ("The Stars in their Seasons," map v.). Venus, sadly shorn of her glory, may also be seen in the east before sunrise. The night sky is an absolute blank as far as the planets are concerned, all (with the problematical exception of Saturn) being too near the sun to be visible. The moon enters her first quarter at 7h. 55·6m. in the morning of the 5th, and is full at 10h. 50·4m. A.M. on the 13th. She enters her last quarter at 5h. 55·7m. in the early morning of the 21st, and is new at 9h. 18·6m. at night on the 27th. Five stars will be occulted by the moon in September during the ordinary working hours of the amateur observer's night. On the 3rd, γ Libra, a star of the $4\frac{1}{2}$ magnitude, will disappear at the moon's dark limb at 9h. 19m. P.M., at an angle of 143° from her vertex. The star will have set ere it emerges from behind the bright limb. On the 7th, B. A. C. 6536, a star of the $6\frac{1}{2}$ magnitude, will disappear at the dark limb at 9h. 43m. P.M., at a vertical angle of 65°. It will reappear at the bright limb at 10h. 33m. P.M., at an angle of 353° from the moon's vertex. On the 10th, B. A. C. 7487, another $6\frac{1}{2}$ mag. star, will disappear at the dark limb of the moon at 8h. 11m. P.M., at an angle from her vertex of 129°; reappearing at her bright limb at 9h. 12m. P.M., at a vertical angle of 234°. The next occultation will not occur until the 20th, when 130 Tauri, a star of the 6th magnitude, will disappear at the moon's bright limb at 11h. 34m. P.M., at a vertical angle of 68°. It will reappear at her dark limb at half-past 12, at an angle of 229° from her vertex. Lastly, on the 21st, when the moon rises, the $5\frac{1}{2}$ mag. star, 26 Geminorum, will already have been occulted. It will be seen to reappear at her dark limb later on at 11h. 26m. P.M., at an angle from her vertex of 273°. At noon, on September 1, the moon is in Virgo, 6° north of Spica ("The Seasons Pictured," plate xxv.), and continues in that constellation until the noon of the succeeding day, when she enters Libra ("The Seasons Pictured," plate xxvi.). Passing through Libra, she arrives at 9 A.M. on the 4th on the western boundary of the narrow northern strip of Scorpio, and, after traversing this, at 6 o'clock in the same evening emerges in Ophiuchus. Here she continues until 2 P.M. on the 6th, when she crosses into Sagittarius. She leaves Sagittarius for Capricornus at 3 A.M. on the 9th, leaving that for Aquarius in turn at 2 A.M. on the 10th ("The Seasons Pictured," plate xxi.). Her passage through Aquarius terminates at 9 A.M. on the 13th, at which hour she crosses into Pisces. She is travelling across Pisces ("The Seasons Pictured," plate xxii.). She does not quit the last-named constellation until 3 P.M. on the 16th, and then she passes into the northernmost angle of Cetus. It takes her 24 hours to cross this, and then at the same hour on the 17th she enters Aries. Here she continues only until 8h. 30m. A.M. on the 18th, when she passes into Taurus ("The Seasons Pictured," plate xxiii.). In her journey through Taurus she arrives at 3 A.M. on the 21st at the outlying north-eastern part of Orion. This she takes 12 hours to cross, and at 3 P.M. emerges in Gemini ("The Seasons Pictured," plate xxiv.). At 6 A.M. on the 23rd she passes out of Gemini into Cancer. She leaves Cancer for Leo at 5h. P.M. on the 24th ("The Seasons Pictured," plate xxiv.), and is in Leo until 2h. A.M. on the 27th, at which hour she quits that constellation for Virgo. She crosses from Virgo into Libra at 10h. 30m. P.M. on the 29th ("The Seasons Pictured," plate xxvi.). She is still in Libra when these notes terminate.

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